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October 31, 1989

Energy Research Abstracts

Abstracts 41410-44406

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

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Energy Research Abstracts

Purpose

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U.S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. Foreign information is obtained through the International Energy Agency's 14-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. **Please note that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

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The citations presented in *ERA* are available for on-line searching as records within the Energy Data Base. The current-year records are available on the Integrated Technical Information System (ITIS). The entire data base is available through commercial on-line vendors.

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Managing Editor, Audrey B. Smith
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Information Sources

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5. **Author affiliation.** Only first one is listed, in parentheses after author(s) to which it applies.
6. **Collaboration,** if present.
7. **Corporate author(s)** identifying corporation responsible for document.
8. **Patent assignee and number** for citations of patent documents or applications.
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18. **Conference title, location, and date,** if applicable.
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21. **Drop note** or explanatory statement.
22. **Abstract.**
23. **Subject descriptors.** Listed only if no abstract or only a brief statement is included.

Sample Citations

Report

18494 (DOE/ER/40438–T1) **[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report.** Haeberli, W. Phys. VI collaboration. Wisconsin Univ., Madison (USA). Dept. of Physics. [1989]. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER40438. Order Number DE89007246/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper briefly discusses the Wisconsin test facility for storage cells; results of target tests; the new UHV...

Report Analytic

18500 (INIS-SU—69, pp. 30-32) **Transition energies in Ne-like ions. Correlation effects.** Vainshtejn, L.A. AN SSSR, Moscow. Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89780060/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Kratkie Soobshcheniya po Fizike.; no. 6.

SILVER IONS/energy-level transitions; XENON IONS/energy-level transitions; CORRELATIONS; D STATES; E STATES;...

Journal Article

19055 **A theoretical and experimental investigation of long-pulse, electron-beam-produced rare gas plasmas.** Brake, M.L.; Repetti, T.E. (Energy Beam Interaction Lab. of the Dept. of Nuclear Engineering, Univ. of Michigan, Ann Arbor, MI (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 16(5): 581-589 (Oct 1988). (CONF-881020–: Symposium on radiation physics, Sao Paulo, Brazil, October 3, 1988).

Visible emission spectroscopy (380-650 nm) has been performed on intense, electron beam (1 kA, 300 ns, 300 kV) produced Ar, Kr,...

Patent

18045 **Polarization of fast particle beams by collisional pumping.** Stearns, J.W. To Dept. of Energy, Washington, DC. USA Patent 4,724,117. 9 Feb 1988. Filed date 19 Oct 1984. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for polarizing a fast beam of particles by collisional pumping, comprising the steps of generating a beam...

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Corporate Author Index
The corporation, organization, or institution responsible for the issuance of the document is listed in this index. The entries are arranged alphabetically and provide the title and citation number of the reference. For example, the listing for the "Report" sample citation would appear as shown at right.

Wisconsin Univ., Madison (USA). Dept. of Physics
[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 14:18494 (R;US)
Wisconsin Univ., Madison (USA). Lab. of Genetics
Organization of the R chromosome region in maize: Final progress report, June 1, 1983–May 31, 1986, 14:18255 (R;US)

Personal Author Index
Each author's name listed on a document cited in this issue is indexed. An index entry provides title and citation number; for secondary and other names, a cross-reference is given to the primary author name where the full index entry is located.

Hadley, D.L., *See* Lee, A.D., 14:17651
Haeberli, W., [Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 14:18494 (R;US)

Subject Index
This index lists the main subject descriptors assigned to each record by indexing professionals. A secondary or qualifier term is used where necessary to describe materials, objects, and processes. Document titles may be enhanced with additional informative phrases where necessary. An excerpt from this index appears at right.

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See also DEUTERIUM
HYDROGEN 4
TRITIUM
Neutron-Rich Isotopes
Study on the strong neutron-rich nuclei of lightest elements, 14:18686 (RA;SU;In Russian)

Contract Number Index
DOE technical reports are listed by contract number. Each entry also provides the primary corporation or organization cited for that contract number. A typical entry is shown.

FG02-88ER40438 **Wisconsin Univ., Madison (USA). Dept. of Physics**
14:18494 DOE/ER/40438–T1
FG02-88ER60664 **Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)**
14:17641 DOE/ER/60664–1

Report Number Index
Technical report literature is indexed by the alphanumerical identifier of the report. Patent documents and conferences are included for convenience. Each entry lists the citation number, the source of availability of the document, an indicator of presence at a GPO depository library, order number, and distribution category. A typical entry is:

DOE/ER/40438–
T1 14:18494 NTIS, PC A03/MF A01 - OSTI E 1.99: DE89007246/JAW MF-411

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The subject content of *Energy Research Abstracts* is arranged as shown below. The two-digit and four-digit category numbers printed here illustrate the category number assignment used in the data base records.* The following list includes all of the 40 first-level and the 289 second-level categories. Because each issue of *ERA* publishes citations only for those documents announced during the past semimonthly period, some subject categories may not be present in every issue.

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*The numerical subject category scheme is used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's data systems. Categories and definitions for the complete set of six-digit numbers are given in DOE/TIC-4584, *Energy Data Base: Subject Categories and Scope*.

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Energy Research Abstracts

01 COAL AND COAL PRODUCTS

0103 Preparation

Refer also to citation(s) 41420, 41426, 41448, 41482

41410 (DOE/PC/88877–T2) **Coal surface control for advanced physical fine coal cleaning technologies: Quarterly report, September 19, 1988–January 31, 1989.** Morsi, B.I.; Chiang, S.-H.; Sharkey, A.; Blachere, J.; Klinzing, G.; Streeter, R.; Gray, R.; Venkatadri, R.; Cheng, Y.S.; Chiarelli, P. Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering. 1989. 77p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88877. Order Number DE89015880/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The overall objective of the project is to develop techniques for coal surface control prior to the advanced physical fine coal cleaning process of selective agglomeration to achieve 90% pyrite sulfur rejection while operating at a Btu recovery greater than 90% based on run-of-mine coal. The surface control is meant to encompass storage, grinding environments and media, surface modification during grinding and laboratory beneficiation testing. The project includes the following tasks: project planning, method for analysis of samples, development of standard beneficiation test, grinding studies, modification of particle surface, and exploratory R & D and support. Progress in each task of the project is presented in this report. 14 refs., 12 figs., 14 tabs.

41411 (DOE/PC/88878–T3) **Coal surface control for advanced fine coal flotation: Quarterly report No. 2, January 1–March 31, 1989.** Fuerstenau, D.W.; Sastry, K.V.S.; Hanson, J.S.; Narayanan, K.S.; Khan, L.; Diao, J.; Yin, Y.; Waltermire, M.; Hu, W.; Zou, Y. California Univ., Berkeley, CA (USA); Utah Univ., Salt Lake City, UT (USA); Columbia Univ., New York, NY (USA); Praxis Engineers, Inc., Milpitas, CA (USA). 1 Jun 1989. 117p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88878. Order Number DE89015781/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

The primary goal of this research project is to develop advanced flotation methods of coal cleaning in order to achieve 90% pyritic sulfur removal at 90% Btu yield, using coal samples procured from six major US coal seams. Concomitantly, the ash content of these coals is to be reduced to 6% or less. The investigation of mechanisms for the control of coal and pyrite surfaces prior to fine coal flotation is an important aspect of the project objectives. A second major objective is to investigate the factors involved in the progressive weathering and oxidation of coal stored in three storage modes, namely, open, covered and in an argon-inerted atmosphere, over a period of twelve months. 37 figs., 41 tabs.

41412 (DOE/PC/88881–T3) **Engineering development of advanced physical fine coal cleaning technologies - froth flotation: Third quarterly report, April 1, 1989–June 30, 1989.** Kaiser Engineers, Inc., Pittsburgh, PA (USA). 1989. 20p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88881. Order Number DE89016387/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The work covered by this award includes the various steps required to develop, engineer, and demonstrate an advanced froth flotation process to the point at which it can be commercialized, following completion of the project. The major goals set by the DOE for the process require the rejection of 90% of the pyritic sulfur content of three widely used United States coal seams coupled with a recovery of 90% of the energy content of the as-mined coals. An attainment of the pyritic sulfur rejection goal could make a significant impact on utility boiler sulfur dioxide emissions while attainment of the energy recovery goal should minimize the cost impact of the process on the bottom-line cost of power generation. Progress is briefly reported.

41413 (DOE/PC/88882–T3) **Ancillary operations in coal preparation instrumentation: On-line low cost sulfur and ash analysis: Third quarterly report, April 1989–June 1989.** Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div. 1989. 23p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88882. Order Number DE89015884/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A status report is presented in the following areas: (1) nebulizer screening tests (tests performed have utilized a variety of coal slurries of Pittsburgh No. 8 coal); and (2) mass opacity meter testing. (CBS)

41414 (EUR–11900-EN) **The interaction of processes in fines treatment plants.** Vickers, F.; Morris, J.; Ivatt, S.; Waltonlves, J.J. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 66p. Available from Commission of the European Communities, Luxembourg.

The aims of the project were to identify and, if possible, quantify the interactions between those unit operations which are combined to form a conventional fine coal treatment process, i.e. froth flotation, vacuum filtration and tailings thickening. The principal results showed that not only is the behaviour of the superfine particles, below 63μm, the predominant influence on fine coal processing, but also the ash weight of superfines can be used to predict the performance of the flotation and filtration operations. 14 refs., 37 figs., 11 tabs.

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Refer also to citation(s) 41443, 41450, 41452, 42780, 43028, 43576

41415 (AD-A–205470/8/XAB) **Production of jet fuels from coal-derived liquids. volume 8. heteroatom removal by catalytic processing. interim report, 1 January-30 August 1988.** Rindt, J.R.; Hetland, M.D.; Knudson, C.L.; Willson, W.G. North Dakota Univ., Grand Forks, ND (USA). Energy and Minerals Research Center. Jan 1989. 99p. Available from NTIS, PC A05/MF A01.

In September 1986, the Fuels Branch of the Aero Propulsion Laboratory at Wright-Patterson Air Force Base, Ohio, began an investigation of the potential of the production of jet fuel from the liquid by-products streams produced by the gasification of lignite at the Great Plains Gasification Plant in Beulah, North Dakota. Funding was provided to the Department of Energy (DOE), Pittsburgh Energy Technology Center (PETC), to administer the experimental portion of this effort. This report details the program with the University of North Dakota Energy and Mineral Research Center (UNDEMRC) to study the removal of heteroatoms and the saturation of aromatics found in the Great Plains tar oil stream. UNDEMRC tested a processing approach consisting of multiple-stage hydrogenations.

41416 (AOSTRA–8808, pp. 13) **The Ohio Ontario Clean Fuels Inc., coal oil coprocessing project in Ohio.** Shannon, R.H. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, 7-12 Aug 1988; CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The U.S. Dept. of Energy and the Ohio Coal Development Office have signed agreements with Ohio Ontario Clean Fuels, Inc., to share in the cost of a $225 million facility that will convert a mixture of high sulfur coal and residual oil into clean burning liquid fuels. The technology, known as coprocessing, uses a chemical process to simultaneously upgrade coal and heavy residual oil. The process is an innovation with respect to the conventional refining technology by which residual oil alone is upgraded. The facility will blend 800

ton/d of high sulfur Ohio coal with 8,675 bbl/d of residual oil. It will produce 4500 bbl/d of gasoline quality naphtha and 7250 bbl/d of middle distillate liquid fuels. These can be used in turbines, or combined cycle additions and utility boilers, or as products or intermediates in refineries. High conversions, over 90%, of the coal and heavy residual oil to clean fuels can be achieved. The project will create 5 bbl/d of oil from each ton of coal blended into the heavy oil. In view of the successful commercial operations of the H-Oil, "oil only" unit at the Texaco Convent LA refinery and elsewhere and the operating success and experience of the H-Coal, 200 ton/d coal-only unit, which did operate in the coprocessing mode at start up, there is a high level of technical confidence in the simultaneous upgrading of coal and oil. The company and the project have also obtained an H-Oil license in the event that such an operation is desirable. Analysis of the costs of other solutions indicates that coal/oil coprocessing is a viable economic alternative for the production of fuels from nonconventional sources and for the control of acid rain pollution. 4 refs., 3 figs., 4 tabs.

41417 (AOSTRA–8808, pp. 11) **The Canadian energy upgrader.** Boehm, F.G. (Canadian Energy Developments, Inc., Edmonton, AB, Canada); Caron, R.D.; Anderson, N.E. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, 7-12 Aug 1988; CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The production of synthetic crude from coal and heavy oil by novel coprocessing technologies being developed by Canadian Energy Development Inc., in cooperation with the Alberta Office of Coal Research and Technology appears to offer considerable commercial potential. Recent screening studies have shown that high quality synthetic crude produced from Alberta subbituminous coal and heavy oil/bitumen is competitive with heavy oil, bitumen, or oil sands derived products. In fact, with current low oil price forecasts, coprocessing appears to offer certain economic advantages over conventional heavy oil upgrading projects as the capital and operating costs are similar and feedstock costs are substantially lower as up to one-third of the heavy oil feedstock is replaced with low cost coal in a coprocessing facility. Two different coprocessing options are being developed, the CCLC High Conversion Hydrogenation Process and the PYROSOL Mild Hydrogenation/Hydrocoking Process. The CCLC Process involves coal solvolysis in a heavy oil slurrying medium followed by moderate severity hydrogenation of the solubilized coal and heavy oil to yield a high quality distillate product, whereas the PYROSOL Process combines mild hydrogenation with coking in the presence of hydrogen to convert the coal and heavy oil fractions to distillate product. Overall distillate product yields (propane/butane, C5+ synthetic crude distillate) of 70-78% of total organic feed (heavy oil plus dry ash-free coal) have been achieved. For a stand-alone upgrader using coprocessing technology, discounted cash flow return on equity rates of 10-15% are indicated with conservative future oil price projections, provided that progressive financing methods are considered. 3 figs., 10 tabs.

41418 (AOSTRA–8808, pp. 20) **Coal/oil coprocessing using ebullated bed technology: An update.** Parker, R.J. (Aalberta Research Council, Edmonton, AB, Canada); Kulik, C.J.; Duddy, J.E. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, 7-12 Aug 1988; CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Since 1985, the Alberta Research Council has been a member of a consortium, which has investigated coprocessing using HRI ebullated technology as a means of upgrading coals and heavy oil resids. Bench unit and autoclave tests have shown that in excess of 90 wt% conversion of the moisture ash free coal and 525^{0}C resid to distillable products and gases can be achieved. Distillable product yields of close to 80 wt% have been obtained. The quality of the distillable oil fractions was high and met product specifications for synthetic crude oils and No. 6 fuel oil without additional hydrotreatment. Recent work has focused on the hydrotreating of the coprocessing derived liquids, catalyst consumption rates, and process mechanisms. Extensive characterization tests were performed on narrow distillation cuts (50^{0}C) to identify the origin of these materials (coal or resid). The response of naphtha, distillate, and gas oil fractions to hydrotreating was evaluated using fixed bed and Berty reactors. Batch autoclave studies determined the influence of hydrogen sulfide and a disposable iron catalyst on process performance. Spent process catalysts were shown to be reactivated by oxidative regenation. In late 1987, the Alberta Research Council joined a development program sponsored by the United States Dept. of Energy entitled Bench-Scale Development of Coal/Oil Coprocessing Technology. A key feature is the evaluation of subbituminous coals, as mined and after beneficiation by the ARC agglomeration procedure at the bench scale. The data obtained will provide the basis of an economic screening study of a coprocessing plant to be located within Alberta. 8 refs., 6 figs., 12 tabs.

41419 (ARC/CR–34) **Alberta Research Council Coal Research Program, 1982-83. Second quarter progress report, July 1, 1982-September 30, 1982.** du Plessis, M.P. Alberta Research Council, Edmonton, AB (Canada). Coal Research Dept. 1982. 61p. (CE–02666). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

Autoclave liquefaction evaluation of Ardley coal (Red Deer Region) was completed for four process types: I.G. Farben (PC-1), CO/Steam (PC-2), Coal-Bitumen (PC-4) and PC-5 (Rapid Heating Short Residence Time). Exploratory evaluation of the effects of H_2S and CS_2 addition to PC-1 and PC-2 with Highvale coal, the least reactive coal, showed a significant increase in both coal conversion and yield of oil plus extract. Results were obtained from bench unit liquefaction tests coal at Grand Forks Energy Technology Centre (GFETC) and Dow Chemicals. Low conversions (63%) were obtained with the GFETC process. High conversions (92%) were obtained in the Dow mini-bench unit, which agrees well with ARC's dispersed catalyst (PC-4) test results (90% conversion) for Highvale coal. In the continuous flow mini-reactor pyrolysis, Highvale coal was tested at reaction temperatures from 550-800 C and 0.4 s. residence time. Total conversion increased from 32% at 550 C to 47% at 800 C on an as received coal basis. Continued investigations involved slurry rheology, surface properties of coal char and catalysts, thermogravimetric analysis of char and coal reactivities and petrographic analysis of coal and liquefaction residues. Supporting activities continued on the development of analytical methods for class analysis of coal derived liquids, simulated distillation by gas chromatography and characterization of coal liquid components. 54 refs., 9 figs., 12 tabs.

41420 (ARC/CR–1983) **ENR-ARC Coal Conversion Research Program. Third quarter progress report, October 1, 1983-December 31, 1983.** du Plessis, M.P. Alberta Research Council, Edmonton, AB (Canada). Coal Research Dept. 1983. 53p. (CE–02667). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This progress report describes bench-scale experiments on the liquefaction and pyrolysis of coals. Services in the analytical chemistry and the measurement of coal and coal products are also provided. Other topics of research are underground coal gasification and coal agglomeration. A sample bank of coals from the Alberta Plains is described, as are the activities of the Coal Technology Information Centre and recent improvements to the research facilities. Lists of external clients and of national and international cooperative research actions are also given. 47 refs., 7 figs., 10 tabs.

41421 (CRIEPI-EW–87005) **Characteristics of a 2T/D pressurized two-stage entrained bed coal gasifier - comparison of various kinds of coals' gasifying characteristics.** Takahashi, S.; Inunaru, J.; Hara, S.; Hamamatsu, T.; Abe, T.; Ishikawa, H.;

Takegawa, T.; Ishigami, S. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Mar 1988. 35p.

It is extremely important to study properties of coal which affect the gasifying performance of a coal gasifier, and to analyze the differences in performance, which are obtained when different types of coal are used, with regard to the design and operation of a gasifier. Using experimental data on six different kinds of coal, this report examines the difference in performance of a 2T/D coal gasifier according to coal variety. The report introduces a new concept, 'standard fixed carbon conversion efficiency', as an index which indicates the performance of a gasifier. In this experiment, it was found that with the exception of Canadian coal, the other five varieties of coal had almost identical standard fixed carbon conversion efficiencies. It was also verified that the calculated values were consistent with the experimental results. Thus, it has become possible to estimate the amount of product gas, product gas calorific value, and cold gas efficiency once experimental conditions are set. It can be concluded that the difference in the performance of a gasifier is governed by the ratio of volatile carbon and fixed carbon contained in coal.

41422 (DOE/MC/22144–2722) **Development of a hot gas cleanup system: Final report.** Anderson, G.L.; Berry, F.O.; Hill, A.H.; Ong, E.; Laurens, R.M.; Shah, R.; Feldkirchner, H.L. Institute of Gas Technology, Chicago, IL (USA). Dec 1988. 166p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-85MC22144. Order Number DE89000937/JAW. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

The overall objective of this program was to develop means for reducing the concentrations of sulfur-containing compounds and HCl in hot coal-derived fuel gas to less than 1 ppM(v). Specific tasks in the program included (1) conducting laboratory-scale studies on selected metal oxide-containing sorbents for removing sulfur-containing compounds at high temperatures, (2) conducting laboratory-scale studies on selected molten carbonate-containing sorbents for removing HCl at elevated temperatures, (3) designing and constructing a 3000 SCF/h bench-scale unit (BSU) to test preferred sorbents, (4) shipping the BSU to METC for testing there, and (5) conducting an engineering and economic assessment on the use of the tested sorbents in integrated coal gasification/combined-cycle power plants and coal gasification/molten carbonate fuel cell power plants. 19 refs., 33 figs., 30 tabs.

41423 (DOE/MC/23261–2723) **Vaporization of trace element species from coal under gasification and combustion conditions: Final report.** SRI International, Menlo Park, CA (USA). Mar 1989. 194p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-86MC23261. Order Number DE89011687/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

The objective of this project was to establish the chemical forms and relative abundance of trace inorganic vapor species in coal during combustion and gasification. A joint experimental and calculational program to observe the vaporization of Illinois No. 6 bituminous and Wyodak subbituminous was performed. Experimental studies were performed by Knudsen cell mass spectroscopy on samples of each coal that were ashed at low temperature by an oxygen plasma. To simulate actual coal more closely, some samples were only partially ashed to retain more of the original organic components. Vapor species were identified and their abundances measured over the temperature range 300-1700 K. In the first year of the program, vaporization from the coal ash alone was studied. Dynamic partial pressures were measured against temperature and time. Vapor species of 32 major or trace elements were identified. During the second year of the program, mass spectrometry experiments addressed the effects of added gases (O_2, CO_2, and H_2O) on the identities and abundances of trace element vapor species. Coincident with experimental studies, trace element vaporization behavior was evaluated by Gibbs energy minimization calculations. A data base including both solution and pure condensed and gaseous components was compiled. The behavior of Wyodak coal at 1 atm total pressure was evaluated over the temperature range 300–1800 K and the oxygen partial pressure range from 10^{-1} to 10^{-25} atm. Results were used to evaluate the effects on trace element volatility of several proposed strategies for containment removal. 13 refs., 23 figs., 23 tabs.

41424 (DOE/PC/50001–49) **Advanced coal liquefaction research: Final report.** Gall, W.; McIlvried, H.G. III. Energy International, Inc., Pittsburgh, PA (USA). Jul 1988. 115p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-82PC50001. Order Number DE89015876/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This study had two objectives: (1) To enhance the fundamental understanding of observed differences in the short contact time, donor solvent liquefaction of bituminous and subbituminous coals. (2) To determine if physical refining of subbituminous coals could be used to give a better feedstock for the first stage of two-stage liquefaction processes. Liquefaction studies using microautoclaves were carried out. Results are discussed. 11 refs., 25 figs., 29 tabs.

41425 (DOE/PC/60797–T4) **Intermediates formed during supercritical desulfurization of coal: Final technical report.** Muchmore, C.B.; Chen, J.W. Southern Illinois Univ., Carbondale, IL (USA). Dept. of Mechanical Engineering and Energy Processes. 22 May 1989. 49p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-83PC60797. Order Number DE89015877/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The precombustion desulfurization process studied is one that utilizes the unique capability of alcohols, under supercritical conditions, to selectively remove organic sulfur from the coal matrix. The overall goal of this research was to determine the nature of the physical forces and chemical reactions operative during desulfurization and conversion of coal by extraction with alcohols under supercritical conditions. Specific objectives included determination of intermediates and reaction products resulting from the reaction of coal with alcohols under supercritical conditions, and elucidating the reaction pathways in the process. Possible pathways for the supercritical desulfurization with alcohols include a direct reaction of the alcohol and/or degradation product with organic sulfur in the coal matrix, or reaction with hydrogen sulfide released from the sulfur containing functional groups present in the coal, thus inhibiting back reaction of the H_2S with the coal matrix and/or the mineral matter in the coal. 7 refs., 23 figs., 12 tabs.

41426 (DOE/PC/79806–8) **Characterization and suitability of superclean coals for hydroliquefaction feedstocks: Final report.** Kim, Nam. Michigan Technological Univ., Houghton, MI (USA). Dept. of Chemistry and Chemical Engineering. 30 May 1989. 397p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-87PC79806. Order Number DE89015875/JAW. Available from NTIS, PC A18/MF A01 - OSTI; GPO Dep.

Superclean coals have been studied for their suitability as liquefaction feedstocks. The effects of ash and sulfur contents and two catalysts on a hydrogen donor solvent liquefaction reaction have been studied. Experiments were run using a unique coal of small particle size (90% <22 microns). The coal was characterized in terms of its chemical and its physical properties. This information made it possible to determine the effects of the static tube flotation separation on the coal. Once characterized the coals were liquefied in the hydrogen donor tetralin under a hydrogen atmosphere of 500 psig. The first series of experiments was to determine the effects of the ash on the liquefaction reaction. The second group of experiments dealt with the effects of catalysts (ammonium molybdate and titanium carbide) on low ash coals at various conditions. A model for batch liquefaction in a hydrogen donor solvent is then developed. This model is based on the assumption that the reaction is due to two competing mechanisms; (1) a thermal decomposition of the coal and (2) a catalytic reaction. The thermal reaction produces unwanted products while the catalytic reaction produces the desired products. To accurately model the batch system, mass transfer is considered. 51 refs., 50 figs., 29 tabs.

41427 (DOE/PC/79813–T2) **Advanced studies of biological indirect liquefaction of coal: Quarterly report, January 20–April 19, 1988.** Arkansas Univ., Fayetteville, AR (USA). 1988. 49p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC79813. Order Number DE89016624/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

During FY 87 a bacterial culture was isolated from animal waste that is capable of converting CO in synthesis gas to ethanol and acetate. An ethanol concentration of 4.3 g/L was obtained in batch culture, and the most favorable ethanol to acetate ratio obtained

was 1.1 g ethanol per g acetate (1.4 gmole ethanol per gmole acetate). The culture has been shown to require a very low level of yeast extract for growth, and agitation was shown to enhance conversion by increasing the rate of CO transfer from the gas phase to the liquid phase. The culture, tentatively identified as Clostridium, produces a higher yield of ethanol and ratio of ethanol to acetate when 2-bromoethane-sulfonic and excess yeast extract are removed from the media. The feasibility of continuous culture operation was demonstrated with the culture by operation in a stirred-tank reactor with continuous liquid and gaseous feeds. Detailed culture identification experiments will be performed to determine if the culture is indeed a new Clostridium species or an existing species capable of utilizing CO as a carbon source. Studies will also be initiated in an attempt to eliminate acetate as a product from CO metabolism, while increasing the concentration of ethanol in the product stream. 15 refs., 21 figs., 1 tab.

41428 (DOE/PC/79933–T8) **Effectiveness factors for hydroprocessing of coal and coal liquids: Progress report No. 7, March 15, 1989–June 15, 1989.** Massoth, F.E.; Seader, J.D. Utah Univ., Salt Lake City, UT (USA). 19 Jun 1989. 25p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-87PC79933. Order Number DE89013220/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The aim of this project is to develop a methodology to predict, from a knowledge of feed and catalyst properties, effectiveness factors for catalytic hydroprocessing of coal and coal liquids. The research entails a study of hydrodenitrogenation of model compounds and coal-derived liquids using three NiMo/alumina catalysts of different pore size to develop, for restrictive diffusion, a relationship that can be used for estimating reliable effectiveness. This quarter, a number of aspects of diffusivity at room temperature were studied. First, a method was developed for estimating the bulk diffusivity of polyaromatic compounds from extrapolation of both experimental data on related compounds and of well-accepted correlations. A tortuosity of 1.3 was determined from measured effective diffusivities for three different solutes using three different sized NiMo catalysts. A series of experimental batch runs on hydrogenation of Ni-tetraphenyl porphyrin in mesitylene and decalin solvents were carried out a 750 psig and temperatures of 300 and 350°C with the NiMo catalysts. 4 refs., 6 figs., 5 tabs.

41429 (DOE/PC/80907–T11) **Reactivity of coal in direct hydrogenation processes: Final report.** Baldwin, R.M.; Miller, R.L. Colorado School of Mines, Golden, CO (USA). Dept. of Chemical Engineering and Petroleum Refining. Jul 1989. 65p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-85PC80907. Order Number DE89016406/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This research program consisted of two facets dealing with fundamental and applied studies on coal reactivity under direct hydroliquefaction conditions. The first facet was concerned with an investigation of the relationship between coal reactivity and coal properties. Data on the rate and extent of direct coal hydroliquefaction for 5 bituminous coals from the Argonne Premium Sample Bank were measured. Data on rate of conversion of coal to THF and toluene solubles were modeled with a simple reversible rate expression, and activation energies for conversion to each solvent solubility class determined. Data on carbon and proton distribution in the coals were obtained by ^{1}H-NMR and ^{13}C-NMR. A strong correlation of activation energy with the aliphatic hydrogen content of the coal was found for conversion to THF solubles. The second facet of the program dealt with a mechanistic study of the effect of hydrogen on the rate and extent of coal liquefaction. The objective was to investigate the effect of radical quenching by aromatic and hydroaromatic vehicles on the activity and selectivity of hydrogen under conditions relevant to direct coal hydroliquefaction. The experimental portion of the program consisted of a series of runs on a model compound system, followed by experiments utilizing 5 bituminous coals from the Argonne Premium Coal sample bank. 45 refs., 14 figs., 17 tabs.

41430 (DOE/PC/88810–2) **Development of analytical procedures for coprocessing: Quarterly progress report, January 1–March 31, 1989.** Vogh, J.W.; Anderson, R.P. National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA). 1989. 9p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88810. Order Number DE89016625/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This is the second quarterly technical report for a project designed to extend our understanding of coprocessing reactions. More specifically, this research is concerned with development of chemical analytical procedures needed to distinguish between materials and compounded classes in the coprocessing products which are derived from the petroleum resid, the coal, or both. Carbon isotope ratios have been used to determine the relative contributions of coal and resid to various coprocessing fractions where the fractions were produced by distillation or solubility fractionation. In the current project, the carbon isotope technique will be utilized with chemical compound type fractionations which have been developed at NIPER. These comprehensive separation techniques will be used initially with coprocessing samples produced in-house with a 2-liter batch autoclave. Later in the project, these techniques will be applied to samples produced on process development units operated by other DOE contractors. 1 ref., 3 tabs.

41431 (DOE/PC/88856–T1) **Surface magnetic enhancement for coal cleaning: Quarterly progress report No. 2, May 1, 1988–July 31, 1988.** Hwang, J.Y. Michigan Technological Univ., Houghton, MI (USA). Inst. of Materials Processing. [1989]. 17p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88856. Order Number DE89015215/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

The progress achieved during this quarter includes the preparation of new magnetizing reagents, the preparation of mineral and coal samples for experiments, the determination of magnetizing reagent dosage for standard tests, and the establishment of a data base of pH effects on the interactions between thirty-five magnetizing reagents and pyrite, kaolinite, quartz, calcite, and bituminous coal. The work is on schedule with the original plan. Some minor modifications have been made from the test plan. These include the addition of a reagent shelf life study, the preparation of five extra magnetizing reagents, and the addition of coal-magnetizing reagents interaction experiments at various pHs. 2 figs., 4 tabs.

41432 (DOE/PC/88917–3) **A new approach in ultrapurification of coal by selective flocculation: Quarterly report.** Moudgil, B.M. Florida Univ., Gainesville, FL (USA). Dept. of Materials Science and Engineering. Jun 1989. 23p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88917. Order Number DE89016378/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The experimental procedures and results on single and mixed mineral studies of coal/refuse system were outlined in the last quarterly report. In this quarter, single and mixed mineral studies of a coal/pyrite system that also contained a sizeable amount of coal refuse were conducted. Pyrite was observed to be well flocculated by Superfloc 362. Another flocculant, Superfloc 16, also showed excellent flocculating capabilities for pyrite as compared to coal. On the other hand, hydrophobic polymer, WCL-762, was observed to flocculate coal more than pyrite. Mixed mineral studies of 90:10 mixtures of coal/pyrite showed loss of selectivity due to heteroflocculation with Superfloc 362. The increase in settling time at lower dosages of SF 362 did not significantly affect the supernatant coal grade. The effect of pH on the supernatant grade was also studied. No selectivity was achieved in the lower pH range whereas potential separation of coal from pyrite was indicated at higher pH values. In the mathematical simulation of selective flocculation, no significant effect on the simulation results was observed when the number of particles was changed from 100 to 300 particles. It was determined that when the impurity component is flocculated, the selectivity decreases as the amount of impurity in the feed is reduced. 3 refs., 9 figs., 6 tabs.

41433 (EPRI-GS–6436) **Gasification of lignite and wood in the Lurgi circulating fluidized-bed gasifier: Final report.** Mehrling, P.; Vierrath, H. Electric Power Research Inst., Palo Alto, CA (USA); Lurgi G.m.b.H., Frankfurt am Main (Germany, F.R.). c Jun 1989. 227p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

North Dakota lignite and wood chip residue (primarily Douglas fir from the US Pacific Northwest) has been gasified in Lurgi's 2 MW (thermal) CFB pilot plant at Frankfurt/M., W-Germany. Tests were carried out at various temperatures with air or oxygen as gasification agent for the production of fuel gas and synthesis gas, respectively. Further parameters varied included feedstock moisture, air preheat, in-situ desulfurization, etc. The tests showed that North Dakota lignite and wood chips represent suitable feedstocks for CFB gasification. Furthermore, data for the design of large scale commercial plants were obtained. 2 refs., 20 figs., 23 tabs.

41434 (EUR–12078-EN) **The development and implementation of a system to adjust automatically, by computer, the heat-input to a coke oven battery.** Hoogovens Groep BV, Ijmuiden (Netherlands); Commission of the European Communities, Luxembourg (Luxembourg). 1989. 97p. Available from Hoogovens Groep BV, Ijmuiden (Netherlands); Commission of the European Communities, Luxembourg.

The objective of this research project was to improve coke oven battery operation by the implementation of a system, based on a dynamic model, to control the heat input automatically. The project involved the following phases: development of a mathematical model of a coke battery; statistical evaluation of actual process data; development of the concept of a heat input control model; implementation of the model in practice. The heat input control model developed is based on a combination of feedback and feedforward control loops. The feed forward control loop takes into account the influence of the expected coking time (expected pushing schedule) and the dynamic behaviour of the coke-end-temperature due to changes of the regenerator-temperature and the pause-time. Other unknown and non-measurable influences are controlled by the feedback loop. The model has a cascade structure. Computerized implementation of the model resulted in a standard deviation in coke-end-temperature of 8.5 degrees C, compared with 14 degrees C when the model was implemented manually and 25 degrees C for conventional control.

41435 (EUR–12082-EN) **The effect of blend and carbonisation variables on coke discharge.** British Coal Corp., Stoke Orchard (UK). Coal Research Establishment; Commission of the European Communities, Luxembourg (Luxembourg). 1989. 119p. Available from British Coal Corp., Stoke Orchard. Coal Research Establishment; Commission of the European Communities, Luxembourg.

Since the introduction of slot-type coke ovens at the end of the nineteenth century, coke-oven operators have, on occasions, experienced difficulties during discharge. These problems were often found to occur when carbonising blends which developed high coking pressures. The damage caused by excessive pressures, and the loss of production caused by disrupted pushing schedules arising from oven 'stickers' are costly to the oven operators. The present report describes work undertaken at the Coal Research Establishment (CRE) into these problems using a 300 kg capacity movable-wall oven. The principal factors which produced high coking pressures were shown to be low volatile-matter content of the oven blend, and high charge bulk density. It was not possible to relate coking pressure to any of the other commonly-measured laboratory parameters. The vertical expansion of the charge was shown to be strongly dependent on its coking pressure. By making use of the fraction (β) of the applied ram pressure which is diverted to the oven walls during compression of the coke. It was concluded that low lateral shrinkage of the charge was likely to be the principal source of coke pushing difficulties in ovens of good condition. In a separate study, the extent of breakage of coke lumps subjected to compressive ram forces was studied. It was found that the coke broke progressively more as the applied ram pressure was increased, and that the extent of this breakage depended on the properties of the parent coal. As well as producing larger coke, slower carbonisation gave rise to coke better able to survive the compressive stresses. Although coke produced in a wider oven tended to fragment more during compression, the mean length of the coke lumps was greater, so the effect of oven width on the stability of the coke column is uncertain.

41436 (MISC–89054) **Bioprocessing of fossil fuels program: Summary of AR and TD sponsored activities for the period 01/01/89 through 03/31/89.** EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 22p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC07-76ID01570. Order Number DE89016364/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

An experiment was conducted to determine the effect of six different microorganisms on Illinois No. 6 solubilized coal. The microorganisms had been previously shown to alter or degrade dibenzothiophene (DBT). Three methods were investigated to determine the effect of the microorganisms on the solubilized coal. The methods were Furrier transform infrared spectroscopy (FTIR), X-ray photoelectron spectroscopy (XPS), and pyrolysis/mass spectrometry (PY-MS). Pyrolysis/mass spectrometry (PY-MS), determines the form of organic sulfur present in the coal by pyrolyzing a sample at high temperature in an inert atmosphere and analyzing the fragments by mass spectrometry. This method can identify the molecular ion from each organosulfur compound produced in the pyrolysis, which requires a library of known compounds as references. Although there is at the present time a limited number of reference compounds, the method does reveal differences or patterns amongst samples. In the present experiment, analysis of the solubilized coal in the presence of organisms C18 and E1 showed an enhancement in the number of terpenoid-like compounds. Additional analysis of the pyroiysis-mass spectral data showed the presence of several organosulfur compounds in bacterially treated coal that were not identified in the untreated coal. These compounds were tentatively identified as dibenzothiophene, benzothiophene and diphenyl sulfoxide. Organosulfur and terpenoid structures may be more resistant to microbial degradation than other coal constituents such as aliphatic or aromatic hydrocarbons. Thus, the enrichment of organosulfur and terpenoid structures in microbially treated solubilized coal may be accounted for either by the degradation of readily metabolized coal components leaving minor components more easily identified such as aliphatic and aromatics or microbes may catalyze the formation of these compounds. 12 figs., 2 tabs.

41437 (PB–89-185862/XAB) **Design and economics of a lignite-to-SNG (substitute natural gas) facility using Lurgi gasifiers for lignite gasification and the Texaco Partial Oxidation Process to gasify Lurgi by-product liquids. Final topical report, April 1985-November 1985.** Smith, J.T.; Smelser, S.C. Fluor Corp., Irvine, CA (USA). 1985. 93p. Available from NTIS, PC A05/MF A01.

A design and cost estimate was prepared for a 250 billion Btu/day lignite-to-SNG plant that uses Lurgi dry-bottom gasifiers to gasify lignite and the Texaco Partial Oxidation (POX) process to gasify the various hydrocarbon liquids produced by the Lurgi process. Also presented are plant performance and economic comparisons between this plant design and a Base Case design prepared previously in which the Lurgi by-product liquids are burned in boilers and superheaters for steam production. The cost-of-gas for the Study Case is approximately 1.5% higher than the cost-of-gas for the Base Case. It is slightly more economical to burn Lurgi liquids than to gasify them in an auxiliary unit, primarily because if liquids are gasified, additional coal-fired boilers are required for generation of process steam and these are substantially more expensive than boilers fired with liquid fuel.

41438 (PB–89-191233/XAB) **Environmental-Monitoring Plan for the Dow Syngas Project. Annual report, April 1, 1986-March 31, 1987.** LeBlanc, G. Louisiana Gasification Technology, Inc., Plaquemine, LA (USA). 26 Jun 1987. 195p. Available from NTIS, PC A09/MF A01.

See also PB–88-143383 and PB–89-191241. Portions of this document are not fully legible.

The Energy Security Act of 1980 established a program to provide financial assistance to private industry in the construction and operation of commercial-scale synthetic-fuels plants. The Dow Syngas Project design is a high-temperature entrained-flow slagging-type gasifier that began operating in 1987. Dow agreed to comply with existing environmental regulations and to develop an Environmental Monitoring Plan (EMP) incorporating supplemental monitoring in areas of potential environmental and health concern, relative to synthetic-fuels facilities. The phases of monitoring in the EMP will test parameters of interest in air, water, and solid waste for evaluating plant operations and for establishing a data base of information for resolving environmental uncertainties relative to replication of synthetic-fuels plants. Activities relative to design and

construction are described in the report. Laboratory implementation, application for a solid-waste landfill, and a hazardous-waste landfill are included.

41439 (PB–89-191241/XAB) **Environmental-Monitoring Plan for the Dow Syngas Project. Annual report, April 1, 1987-March 31, 1988.** LeBlanc, G. Louisiana Gasification Technology, Inc., Plaquemine, LA (USA). 27 Jun 1988. 129p. Available from NTIS, PC A07/MF A01.

See also PB–89-191233 and PB–89-191258. Portions of this document are not fully legible.

The Energy Security Act of 1980 established a program to provide financial assistance to private industry in the construction and operation of commercial-scale synthetic-fuels plants. The Dow Syngas Project design is a high-temperature entrained-flow slagging-type gasifier that began operating in 1987. Dow agreed to comply with existing environmental regulations and to develop an Environmental Monitoring Plan (EMP) incorporating supplemental monitoring in areas of potential environmental and health concern, relative to synthetic-fuels facilities. The phases of monitoring in the EMP will test parameters of interest in air, water, and solid waste for evaluating plant operations and for establishing a data base of information for resolving environmental uncertainties relative to replication of synthetic-fuels plants. Monitoring of start-up and commissioning activities are described in the report, including laboratory methods, ground-water monitoring, quality assurance/quality control and annual air quality data summaries.

41440 (PB–89-191258/XAB) **Environmental-Monitoring Plan for the Dow Syngas Project: commissioning phase preliminary report, April 1, 1987 through June 30, 1988: Volume 1-4.** LeBlanc, G. Louisiana Gasification Technology, Inc., Plaquemine, LA (USA). 29 Sep 1988. 649p. Available from NTIS, PC A99/MF A01.

See also PB–89-191241 and PB–89-191233. Portions of this document are not fully legible.

The Energy Security Act of 1980 established a program to provide financial assistance to private industry in the construction and operation of commercial-scale synthetic-fuels plants. The Dow Syngas Project design is a high-temperature entrained-flow slagging-type gasifier that began operating in 1987. Dow agreed to comply with existing environmental regulations and to develop an Environmental Monitoring Plan (EMP) incorporating supplemental monitoring in areas of potential environmental and health concern, relative to synthetic-fuels facilities. The phases of monitoring in the EMP will test parameters of interest in air, water, and solid waste for evaluating plant operations and for establishing a data base of information for resolving environmental uncertainties relative to replication of synthetic fuels plants. The report discusses baseline data, sampling and analytical techniques, quality assurance/quality control, and state and federal permits associated with initial operations of the syngas facility.

0105 By-products

Refer also to citation(s) 41415, 41604, 41605

41441 (CU-CPE–1981) **Preparation of activated carbon from sub-bituminous Alberta coals.** Tollefson, E.L.; Hall, E.S. Calgary Univ., AB (Canada). Dept. of Chemical and Petroleum Engineering. 1981. V Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1.

Conditions required for preparation of granular activated carbon, suitable for water treatment, have been investigated using subbituminous Alberta coals as a raw material. Activation parameters examined include: preoxidation time and temperature, and steam activation time. Parameters used to monitor the activation process included steam conversion, gasification rates, yield, ash content, porosity, and pore size distribution. Sorption numbers in addition to specific surface areas were used as measures of product quality. Limited comparative studies of the effects of coal rank were also done. Comparison of the 4 coals tested reveals large differences not only in reactivity but also in quality of carbons produced, thus establishing choice of coal source as an important parameter in production of activated carbon. It was found that higher quality products were obtained in better yield when the mildest conditions at which the steam-carbon reaction occurs were chosen. A compromise was found to be necessary between maximizing product quality and minimizing activation times. Steam activation times required for best product obtainable at a given temperature were different for each coal studied. Kinetic data obtained for the activation process also relate to possible production of fuel gases from coals. It was also found that neither thermal nor oxidative pretreatment conditions would improve carbon quality. Specific surface area and particle size do not completely define the value of a given activated carbon for a particular usage. Low ash content in starting material is a factor in production of higher quality carbons. 11 refs., 35 figs., 9 tabs.

41442 (EUR–11412-FR) **Study of metallurgical aspects of pulverized coal injection at blast furnace.** Lassat de Pressigny, Y. de; Cure, J.L.; Galparoli, A.; Hug, P.; Libralesso, J.M.; Offroy, C.; Picard, M.; Redt, V.; Spatazza, J. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 165p. (In French). Available from Commission of the European Communities, Luxembourg.

Blast furnace No.2 of Usinor in Dunkirk has been equipped with a pulverized coal injection facility which started in July 1983. By this time, Irsid had engaged a study of metallurgical and scientific aspects of coal injection, a study which was realized with the financial support of ECSC. Pulverized coal injection has drastically improved the blast furnace operation and record operating data have been realized with a coal rate of 143 kg of low volatile coal per tonne of hot metal and a coke rate of 333 kg/thm. A deeper analysis of the results shows the influence of coal injection on blast furnace internal parameters and reduction of iron oxides. Problems of tuyere wear have been encountered in Dunkirk and they have been studied by theoretical and practical ways. A mathematical model of the coal jet trajectory shows that it should pass away from the tuyere wall but acoustic phenomena make it unstable and cause periodic impingement. A study of coal combustion shows that the low volatile coal used does not ignite before entering the raceway and probing in the raceway depicts the influence of coal injection on its thermal characteristics. A fundamental study of combustion shows the influence of both the heating rate and the reached temperature on the release of volatiles and reactivity of the produced char.

41443 (EUR–12079-EN) **Pitch insolubles - their nature, properties and substitution.** Tar Industries Services, Chesterfield (UK); Commission of the European Communities, Luxembourg (Luxembourg). 1989. 83p. Available from Tar Industries Services, Chesterfield (United Kingdom); Commission of the European Communities, Luxembourg.

Two examples of low-solids by-product tars from modern coke-oven installations have been distilled in the laboratory to produce pitches of properties similar to those of conventional electrode binders, apart from the low contents of quinoline-insoluble matter. Three further pitches were prepared in which the content of quinoline insolubles had been boosted to conventional levels (8-12 mass%), in one case by dispersing carbon black in one low-solids tar prior to distillation, and in the second and third cases by air blowing a soft pitch derived from the other low-solids tar, at elevated temperature. These five experimental pitches and seven commercially-produced anode binder pitches were fully characterized using conventional anode binder specification tests and some additional tests including analysis for a wide variety of contaminant elements. Two pilot-scale experimentally produced pitches used in an earlier ECSC research project were also examined. Bench-scale test electrodes were produced from all fourteen pitches using a prebaked-type anode formulation with petroleum coke aggregate obtained from an aluminium producer. The physical and reactivity properties of the test electrodes were measured. The results indicate that low-QI binders prepared from modern coke-oven by-product tars could probably be used to produce baked carbons having satisfactory performance as prebaked anodes for aluminium cells. If it is regarded as desirable to enhance the QI content of the pitches to match existing anode binder specification, addition of carbon black either to the tar prior to distillation, or to the petroleum coke aggregate when producing electrodes, appears to be a satisfactory option on physical and reactivity grounds. Air-blowing is regarded as a less satisfactory proposition for reasons connected with the rheology of the derived electrode pastes.

41444 (PB–89-864706/XAB) **Coal tar technology. January 1970-June 1989 (Citations from the NTIS data base). Report for January 1970-June 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 168p. Available from NTISPC N01/MF N01.

Supersedes PB–88-864483.

This bibliography contains citations concerning various aspects of coal tar. Topics include production from coal gasification, synthesis of chemicals from coal tar, and chemical analyses of coal tar products. Toxicology, pollution studies, and commercial uses of the product are also discussed. (This updated bibliography contains 271 citations, 21 of which are new entries to the previous edition.)

0106 Properties

Refer also to citation(s) 41410, 41411, 41413, 41419, 41420, 41423, 41424, 41425, 41426, 41431, 41472, 41497, 41581

41445 (ACIRL-PR–87-4) **Automated coal and coke petrography.** Handley, K.; Cudmore, J.F. Australian Coal Industry Research Labs. Ltd., North Ryde (Australia). Jun 1987. 31p. Available from Australian Coal Industry Research Labs. Ltd., North Ryde.

Under the National Energy Research Development and Demonstration Program (NERDDP) sponsored project ACIRL acquired and commissioned an Image Analyser (Quantimet 900) for coke and coal studies. The project procedures involved measuring the porosity of coke, pore size and cell wall thickness because they are important to fracture propagation and access to oxidising gases. It is considered that the strongest cokes are those with small uniform pores and thick cell walls. Larger pores and their shape are considered to be important zones of weakness. The significance of coke characterisation by image structural analysis is that one of the most important physical properties of metallurgical coke, its mechanical strength, is governed by defects in its structure. Computerised image analysis has enabled a detailed structural evaluation to be made in a reasonable time frame. Because coke from an oven is heterogeneous in nature, a relatively large sample and number of measurements have to be made to obtain meaningful repeatable results. Only an automated image analyser is able to perform this task. The coke microstructural parameters obtained supplement the more conventional parameters such as coke drum indices e.g. Japanese Industrial Standard DI_{15}^{30}, DI_{15}^{150} and coke strength after reaction and with tensile strength determinations provide a more complete characterisation of coke. The procedure by which a representative coke sample was obtained encompassed drilling out cores of coke from lumps containing a standard half Micum sample. The project also addressed procedures for obtaining reliable and meaningful vitrinite reflectances. The rapid method adopted related the random reflectance obtained to mean maximum reflectance.

41446 (CRIEPI-U–87098) **Application of a neutron moisture gauge to the coal ash layer and to measurement of ground water flow.** Shimogaki, H. Central Research Inst. of Electric Power Industry, Tokyo (Japan). 1989. vp. (In Japanese).

This report studies basic detection characteristics for measuring the content of moisture in the sample by use of a neutron moisture gauge and at the same time discusses problems in the coal ash layer containing elements which cause deceleration and absorption of neutrons, as well as a new application of this measuring device: (1) From the neutron diffusion equation, the distribution of thermal neutron fluxes in the sample was analytically studied, theoretically clarifying that the measuring volume varies with the moisture content and the ratio of detection decreases if the clearance between the probe and the inserted pipe is large. (2) As for boron, it was found from the analytical result that the ratio of detection considerably decreases even if the content in the sample is small because the absorption action of a thermal neutron is large. When measuring the moisture in the coal ash layer, therefore, it is necessary to draw a calibration curve which differs from that of ordinary soil. (3) The generation ratio of thermal neutron flux in heavy water is about 40% of light water according to analytical results. From this, it has been identified that if heavy water is poured into ground water as a tracer the flow direction and velocity of ground water can be fully detected with a neutron moisture gauge.

41447 (DOE/PC/88924–3) **Thermodynamics of the solvent swelling of coal: Progress report, March 1, 1989–May 31, 1989.** Green, T.K. Western Kentucky Univ., Bowling Green, KY (USA). Dept. of Chemistry. 1989. 7p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88924. Order Number DE89016626/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The sorption of benzene by an Illinois No. 6 pyridine-extract and its O-methylated derivative was studied over a range of vapor pressures. We have interpreted the gravimetric sorption curves in terms of a dual-mode sorption mechanism originally developed to explain the sorption behavior of glassy polymers. According to this model, the sorption process consists of rapid, hole-filling by the solvent, followed by slow, first-order relaxation or swelling of the extract. The amount of swelling of the extracts has been estimated and Flory interaction parameters (χ) have been calculated for both extract-benzene systems. The χ parameters are independent of vapor pressure and their magnitudes are consistent with the observed general insolubility of the extracts in liquid benzene. An O-octylated extract was also studied. This material behaves more like a rubbery material in benzene and a single-mode swelling mechanism is proposed. The magnitude of the χ parameter calculated for this system is consistent with the observation that the extract nearly completely dissolves in liquid benzene.

41448 (DOE/PC/88934–T2) **Enhancement of surface properties for coal beneficiation: Technical progress report, April 1, 1989–June 30, 1989.** Chander, S.; Aplan, F.F. Pennsylvania State Univ., University Park, PA (USA). 1989. 7p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88934. Order Number DE89016379/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The main objective of this research program is to study ways to modify surface properties of coal, pyrite and ash-forming mineral matter for beneficiation of fine coal. Since the differences in surface properties of coal and mineral matter are utilized in several oil based preparation technologies, such as: froth flotation, emulsion flotation, spherical agglomeration and liquid-liquid separation, another objective is to delineate the role of oil. Progress is discussed.

41449 (DOE/PC/90539–T6) **Volatiles trapped in coals: September 15, 1986–September 14, 1989.** Halpern, J.B.; Sutter, J.R. Howard Univ., Washington, DC (USA). Dept. of Chemistry. 12 Aug 1989. 21p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-86PC90539. Order Number DE89016362/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Results of Raman spectra across two suites of coal samples are presented. The first set as a rank suite of eleven (11) samples from the DOE set. The second was a suite of six high volatile A bituminous samples from the Lower Kittanning seam. 17 figs.

41450 (PB–89-188890/XAB) **Electron-transfer reactions of coal model compounds. Final report, January 1986-August 1988.** Penn, J.H. West Virginia Univ., Morgantown, WV (USA). Dept. of Chemistry. Apr 1989. 50p. Available from NTIS, PC A03/MF A01.

See also PB–88-197405.

Oxidation of benzpinacol (BPC) and diphenyldimethylpinacol (DPB) was effected with two Fe(3)(1,10-phenanthroline)3 complexes. The products of these reactions are exclusively the corresponding ketones when 2,6-di-t-butylpyridine is added to the solution. The rates of the electron-transfer processes were determined by monitoring the change of the Fe(2) and Fe(3) species by uv-vis spectroscopy. The energy required for the reactions was found to be ca. 10 kcal/mole lower than predicted, based on the redox potentials of the electron-donor and the electron acceptor. The mechanism of these electron-transfer reactions appears to be complex. In addition, electron transfer reactions utilizing 9,10-dicyanoanthracene were shown to cause the bond cleavage of model coal compounds. Mechanistic studies have shown that molecular oxygen causes a radical chain-reaction mechanism for bond cleavage following the electron-transfer event, signifying that a minimum of 4 bonds are cleaved in each electron-transfer event.

41451 **Atomization of coal slurries.** Krishna, C.R. (Brookhaven National Laboratory, Upton, NY (USA). Dept. of Applied Science). pp. 459 of Interfacial phenomena in coal technology. Botsaris, G.D.;

Glazman, Y.M. (eds.) Marcel Dekker, Inc., New York, NY, USA (1989).

Discusses the process of drop formation in liquid atomization and experimental results on coal slurry atomization relating to coal-oil mixtures, coal-water mixtures and secondary atomization. 22 refs., 13 figs.

41452 **Role of free radical chemistry on oxidative stability of coal pyrolysis liquids.** Usmen, R. (USDOE Morgantown Energy Technology Center, WV (USA)); Khan, R. *Fuel Processing Technology (Netherlands),* 22(2): 151-158 (May 1989).

A better understanding of the weathering mechanisms of pyrolysis liquids may lead to improved methods of storage of these liquids. The results of a 22-week study of pyrolysis liquid properties during storage at various conditions confirm that free radicals are important in the chemical reactions that cause property changes. Past research suggested that oxidation of liquid fuels involves free radical mechanisms (e.g., via peroxide formation), but there was relatively little data on mild pyrolysis liquids in the literature. The results indicate a significant increase in free radical concentrations for samples of pyrolysis liquids stored in air (in dark or under sunlight). The sample stored in air under sunlight appears to be highly viscous. The changes in the free radical concentration during storage in air verify that the oxidation reaction involves a free radical mechanism. This study also demonstrates that additives such as cyclohexanol can inhibit oxidative weathering by stabilizing free radicals, possibly by hydrogen bonding between the additive and the fuel constituents. 24 refs., 3 figs., 1 tab.

41453 **Alkaline size-exclusion chromatography of lignins and coal extracts using cross-linked dextran gels.** Himmel, M.E. (Solar Energy Research Institute, Golden, CO (USA). Biotechnology Research Branch); Oh, K.K.; Quigley, D.R.; Grohmann, K. *Journal of Chromatography (Netherlands),* 467(1): 309-314 (21 Apr 1989).

'Conventional gel permeation chromatographic' analysis was applied to Superose columns calibrated with alkali-stable standard polymers and low-molecular-weight acidic compounds. These compounds are similar in chemical structure to the polyphenolic or acidic biopolymers examined. Also, theoretical plate analysis for sodium azide elution showed the column system used in this study had 1.5×10^4 plates per meter, which is 10-100 times that possible with open-column type packing materials, such as Sephadex. Rigid, organic polymer-based packing materials for prepacked columns, such as TSK-gel PW series, although stable at pH 14, are quite hydrophobic and may retard the elution of polyphenol-containing polymers. Superose, the high-performance, alkali-stable, cross-linked dextran gel material, appears to be an ideal support matrix for SEC in strongly dissociating, high ionic strength solvents such as 0.1 M sodium hydroxide. 17 refs., 3 figs.

0108 Waste Management

Refer also to citation(s) 41487, 41921, 41922, 41923

41454 (CRIEPI-U-13) **Development of a new type compound cement using coal ash.** Aoyagi, Y. (and others). Central Research Inst. of Electric Power Industry, Abiko, Chiba (Japan). 1989. vp. (In Japanese). Available from Central Research Inst. of Electric Power Industry, Abiko, Chiba (Japan).

'New type compound cement' is a cement which is made by burning lime stone and coal ash as main raw materials. Coal ash is used as a substitute for clay. Gypsum and water-granulated blast furnace slag are added to finely granulated clinker. The cement is classified as a kind of blast furnace cement according to Japanese specification for cements. A burning test was conducted in a plant of industrial scale to ascertain the basic properties of the cement and the concrete mixed with the cement. Four kinds of clinkers were burned in a modern operating kiln From 5000 tons of clinkers the most appropriate kind was selected and three kinds of cements different in the amount of slag mixture were tested. The main results of the test are : (1) The content of C3A almost twice as much as that in the ordinary portland cement. The defects caused by increased quantity of C3A were compensated by the mixtures of finely granulated slag, keeping the advantageous properties of active hydration and high early strength development. (2) High unburned carbon content of coal ash, which is detrimental when used as an admixture for concrete, contributes to reduction of fuel cost, resulting in the saving of production cost of cement. (3) Two kinds of concretes which were intended for civil engineering and building structures were tested using the new type cements as well as an ordinary portland cement and a blast furnace cement. The test results on setting time, compressive strengths, and neutralization depth were evaluated. Except for neutralization the concretes made with the new type cements are comparable to those of commercial cements. Other properties, such as freeze-thaw resistance, drying shrinkage etc., are almost the same. (4) Durability tests of the concretes are now under way, which include observations of concrete blocks with dimensions of 1 x 1 x 1m.

41455 (DOE/PC/88866-T3) **Flue gas conditioning for fabric filter performance improvement: Quarterly technical progress report, April-June, 1989.** Miller, S.J. North Dakota Univ., Grand Forks, ND (USA). 1989. 28p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88866. Order Number DE89016377/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The general objective of this project is to develop a particulate control technology that can reliably remove particulate matter with particle diameters from 0.01 to 10 micrometers from a flue gas stream, at a removal efficiency of at least 99.9% for all particle sizes, independent of coal type. Specific objectives include the following: (1) Show that conditioning with ammonia and SO_3 is an effective means of achieving at least 99.9% fine particulate removal with a fabric filter for two coals, when using reverse-air cleaning with a full-size bag. (2) Measure fine particulate emissions and baghouse pressure drop (with and without conditioning) as a function of time when employing reverse-air cleaning. (3) Measure bag weight as a function of time and cleaning cycle to determine if conditioning will result in a lighter residual dust cake with reverse-air cleaning. (4) Verify that concentrations of conditioning agents, determined from earlier work, will be effective in longer-term tests with reverse-air cleaning, and (5) Further determine the mechanism by which conditioning reduces both fine particle emissions and pressure drop. 8 figs., 6 tabs.

41456 (DOE/PC/88868-T1) **Characterization and modification of particulate properties to enhance filtration performance: Quarterly technical progress report, September-November 1988.** Robinson, M.S.; Snyder, T.R.; Bush, P.V. Southern Research Inst., Birmingham, AL (USA). 22 Dec 1988. 38p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88868. (SRI-ENV-88-1215-6666). Order Number DE89015879/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The testing of the filtration performance of the non-cohesive ash from the TU Electric Monticello Generating Station has begun. Three tests using 996T fabric (100% exposed surface texturization) and an unaltered inlet ash size distribution have been completed. In these tests dustcakes were developed on the fabrics without subjecting them to reverse-gas cleaning cycles. This procedure permitted the rapid buildup of relatively uniform dustcakes, which were then characterized by various analytical tests. These tests were used to verify that the sampling and filtration systems were operating consistently with past field experience, and that they would yield dustcakes with the expected filtration properties. The wind tunnel was modified to optimize the sampling conditions, which will shorten the duration of individual tests. Task 3 includes a literature review which is under way to identify potential ash conditioning agents. Several agents and recommended mixing ratios have been identified. Some initial tests have been performed with ammonia and SO_3 combined at various stoichiometric ratios. The products of these tests have been analyzed in an attempt to determine the mechanism by which these compounds alter ash cohesivity. 4 refs., 15 figs., 6 tabs.

41457 (DOE/PC/88874-T4) **Theoretical approach for enhanced mass transfer effects in-duct flue gas desulfurization processes: Quarterly report No. 4, April 1, 1989-June 30, 1989.** Tischer, R.E. Acurex Corp., Research Triangle Park, NC (USA). Environmental Systems Div. 14 Jun 1989. 89p. Sponsored by U.S.

DOE Fossil Energy. DOE Contract AC22-88PC88874. Order Number DE89015881/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This quarter, bench-scale experiments have been conducted to measure the mass transfer and kinetic rates at simulated duct injection conditions. Section 2 summarizes the tank reactor test results. The stirred tank reactor (Task 2.1) was designed to simulate the gas/liquid interface of a slurry droplet exposed to SO_2. The measurements of the gas and liquid mass transfer coefficients were completed. Preliminary tests were run with chemically inert solids present in the solution of hydrochloric acid. Section 3 reports results from a differential reactor (Task 2.2). Mississippi hydrated lime was prehumidified for 4 min prior to contract with synthetic flue gas in a packed bed reactor. The reaction times tested ranged from 10-7,200 s. The differential apparatus and method are being modified to determine the effect of initial after content on the solids reactivity. Solids containing varying amount of moisture will be investigated. Experimental results from a Short-Time Differential Reactor (STDR) (Task 2.3) are presented in Section 4. Gas phase mass transfer and chemical reaction steps could be excluded as rate limiting, leaving the solid phase diffusion as a rate limiting step in the reaction of dry $Ca(OH)_2$ with SO_2. Higher relative humidity promoted conversion of the sorbent. Sorbents with high surface area will be produced and used for future solid phase diffusion experiments. The progress of slurry injection computer modeling (Task 3.1) is presented in Section 5. The computer code was transferred from the VAX to a CRAY computer to reduce the computation time. Results are presented in Section 5 to illustrate the effects of $CA(OH)_2$ reactivity and concentration on relative gas/liquid mass transfer resistance. Results are also presented that desceibe gas film resistance as a function of SO_2. 13 refs., 42 figs., 7 tabs.

41458 (DOE/PC/90510–T2) **Abatement of gaseous pollutants in coal-combustion exhaust gases employing a solid-oxide electrolyte: Progress report No. 1, 1 October–31 December 1986.** Mason, D.M. Stanford Univ., CA (USA). Dept. of Chemical Engineering. Feb 1987. 6p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-86PC90510. Order Number DE89016402/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We are studying the basic chemical and diffusional-rate processes that will determine whether or not it is feasible to remove electrochemically the pollutants NO_x and SO_x from coal-gas combustion flue gases employing a Y_2O_3-stabilized ZrO_2(YSZ) disk flow reactor. An investigation of the mechanism of the electrocatalytic reduction of these species to the elements is underway. The disk-shaped differential flow reactor system has been constructed to test the electrocatalytic reaction-mechanisms and surface-diffusion models under the simple, controlled fluid mechanics conditions of stagnation flow. We are using bottled gases with composition of pollutant species NO (0.0l, 0.10, and 100 m/o) and SO_2 (0.10 and 100 m/o) in He as an inert carrier gas. We are operating under conditions involving the following variables: electrical overpotentials (0-1 v); current densitities (0-500 mA/cm^2); temperature 500-800°C; total pressure 1 atm; and flow rates adjusted so as to be outside the gas-phase diffusion regime 1-10 mls^{-1}. The porous metal electrodes are prepared from Englehard pastes of Ni, Pt, and Au the latter pair providing comparative catalytic standards for the more practical Ni electrode. Experiments have been designed to get information on the chemical dynamics of NO_x of SO_x dissociation and also the relative rate of electro-reduction of NO_x–SO_x compared to 0_2.

41459 (DOE/PC/90510–T4) **Electrochemical abatement of gaseous pollutants in coal-combustion exhaust gases employing a solid-oxide electrolyte: Progress report No. 3, 1 April–30 June 1987.** Mason, D.M. Stanford Univ., CA (USA). Dept. of Chemical Engineering. Jul 1987. 5p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-86PC90510. Order Number DE89016400/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Electrochemical measurements (32 tests) have been made with the YSZ (yttria stabilized zirconia) disk reactor for the anodic oxidation of O^{2-} and the cathodic reduction of O_2 for temperatures in the range 600–900°C and at concentrations of O_2 from 10ppM in helium to 100%. A thorough understanding of the electrocatalytic mechanisms involving these simple oxygen species is being obtained to provide a background for interpreting the more complex kinetics of NO and SO_2 dissociation. 2 figs.

41460 (DOE/PC/90510–T5) **Electrochemical abatement of pollutants NO_x and SO_x in combustion exhaust gases employing a solid-oxide electrolyte: [Quarterly report, July 1–September 30, 1987].** Mason, D.M. Stanford Univ., CA (USA). Electrocatalysis Lab. 1987. 9p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-86PC90510. Order Number DE89016399/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper summarizes the material presented orally at the October 14-16, 1987 Contractors Review Meeting, at METC on: Advanced Research and Technology Development - Direct Utilization, Instrumentation, and Diagnostics. Highlights of the reaction-rate data for relative dissociation rates of NO and O_2 obtained employing the electrocatalytic disk reactor, were presented. Also initial experiments to characterize the electrolyte surface and to determine the F-center population by a photoluminescence technique were described. 7 refs., 5 figs.

41461 (DOE/PC/90510–T6) **Electrochemical abatement of gaseous pollutants NO_x and SO_x in coal-combustion exhaust gases employing a solid-oxide electrolyte: Progress report No. 5, October 1–December 31, 1987.** Mason, D.M. Stanford Univ., CA (USA). Dept. of Chemical Engineering. [1987]. 7p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-86PC90510. Order Number DE89016398/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Since the last report over two hundred experimental runs have been made in which the relative rates of cathodic reduction of NO compared to O_2 were obtained in the temperature range of interest for flue gas treatment (FGT) reactors: 400–700°C. Erbia (Er_2O_3) stabilized-bismuth oxide (Bi_2O_3) [ESB] of composition $(Bi_2O_3)_{0.80}(Er_2O_3)_{0.20}$ was chosen as the moderate temperature solid-electrolyte which has about the same oxygen-ion conductance in the above temperature range as YSZ has at 700–1000°C. The reactivity of NO and O_2 on ESB at 600°C was found to be comparable to that of YSZ at 850°C, the temperature range for combustion gas cleanup. This important result, for practical FGT-reactor design at moderate temperatures, again supports the hypothesis that electronic defects such as F-centers associated with the oxygen-ionic conductance of the electrolyte provide the electrocatalytic active sites, overshadowing the Arrhenius-temperature effect for the dissociation kinetics of the given oxygen species. As was found with YSZ, NO on ESB is selectively electro-reduced to N_2 as compared to O_2 around 500°C; however, above 600°C NO and O_2 appear to be reduced at about the same rate. This interesting change in selectivity and mechanism is also accompanied with a change in activation enthalpy: 30 kcal/mole below 600°C and 10 kcal/mole above 600°C. 6 refs., 4 figs.

41462 (NEI-DK–130) **Flue gas purification. Reduction of NO_x content - problems in connection with desulfurization system.** Nielsen, K.K. Niro Atomizer A/S, Soeborg (Denmark). Oct 1988. 102p. (In Danish). Available from Niro Atomizer A/S, Soeborg (Denmark).

Niro Atomizer, subsidized in Denmark by the Energy Research Programs EFP 82 and EFP 83, has developed a combined process for the elimination of SO_x and NO_x from flue gas by altering the functions of the spray absorber and the filter and by adding sodium hydroxide to the usual absorber. The process is effective, but results in the production of nitrogen dioxide which colours smoke brown. Research has concentrated on methods for eliminating this discoloration. It was found that the presence of ammonia increased the total absorption of nitrogen oxides but the reduction was only sufficient when ammonia emission was unacceptably high. The addition of active carbon resulted in no emission of nitrogen dioxide, but the total absorption of nitrogen oxides fell drastically. All additives that resulted in satisfactory NO_x absorption contained sodium ions. All additives that resulted in NO_x absorption resulted in the production of NO_2 which gave no NO_2 emission, but an unacceptably high emission of ammonia. Operational parameters such as temperature, etc. which exist when NaOH is used as an additive and which are important for obtaining a satisfactory result, are

equally important in this respect when other additives containing Na are utilized. No additive has been found which can hinder the production of NO_2 without it following that absorption of NO_x is reduced, or that an unacceptable secondary pollution occurs. Analysis of reaction products shows that the absorbed NO_x can be found as nitrogen. 30-70% of the total quantity is composed of nitrates. It has not proved possible to identify other nitrogen compounds because of a lack of suitable analysis techniques.

41463 (NEI-DK–177, pp. 23) **Synthetic gravel from dry flue gas desulfurization end- products.** Donnelly, J.R. (A/S Niro Atomizer, Soeborg (DK)); Joens, E.; Webster, W.C. Geoteknisk Inst., Lyngby (Denmark); Niro Atomizer A/S, Soeborg (Denmark). Feb 1989. In *Deformation and frost-resistant characteristics of desulfurization products.* Order Number DE89902273/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Energiministeriets Energiforskningsprogram. Miljoe og restprodukter.; EFP-83.

A new technology for flue gas desulfurization has been developed over the past seven years. This technology, Spary Drying Absorption, has gained wide acceptance with the number of megatwatts now committed to dry FGD sysems exceeding 4000 megawatts. The first full sized dry FGD system started up in December 1980 on units 6 and 7 of Northern States Power's Riverside Generating Station in Minneapolis, Minnesota. This process produces an essentially dry product with handling properties similar to fly ash. The dry end-product is composed primarily of fly ash, calcium sulfite and sulfate, and excess calcium hydroxide. Methods for disposal and utilization of these end-products are being developed. One potential use of these end-products is the production of a synthetic gravel for use as an aggregate in readbase and concrete composition. Niro Atomizer has investigated the use of a pelletizer to produce a dense hard sythetic gravel. Results of these investigations are presented. These investigations have included preparation of single pressed pellets, laboratory continuous pelletizing and industrial scale demonstration. Properties of the pellets produced are given. A cost estimate for a 400 MW power plant pelletizing system is given. (author).

41464 (NEI-DK–177, pp. 8) **Application to road construction of by-products of flue gas desulphurization.** Foged, N. (Geoteknisk Institut (DK)); Joens, E. Geoteknisk Inst., Lyngby (Denmark); Niro Atomizer A/S, Soeborg (Denmark). Feb 1989. (In Danish). In *Deformation and frost-resistant characteristics of desulfurization products.* Order Number DE89902273/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Energiministeriets Energiforskningsprogram. Miljoe og restprodukter.; EFP-83.

When new materials are to be evaluated with regard to their application in road construction, it is often done after standard methods used for known materials. This involves a risk of misjudgement of the new material. A synthetic gravel material produced of the the end product from a coal-fired power station has been tested according to different routine methods. The gravel material showed less good properties, especially as concerns impact and wear resistance. In order to achieve a better estimation of the material in relation to the functional requirements, an alternative test program has been performed, starting with the investigation of the individual particles and concluding with full scale plate-loading tests. It can be concluded that the material has good strength characteristics. The limiting factor for its application are the elasticity properties. The synthetic gravel materials can be applied in part of the road base where the requirements to the E-module are 100 MN/m^2 or less. (author) 16 refs.

41465 (NEI-DK–177, pp. 54) **Frost sensitivity of desulphurisation by-products. Laboratory investigation of hardened dry product and dry product in pellet form.** Foged, N. (Geoteknisk Institut, Lyngby (DK)). Geoteknisk Inst., Lyngby (Denmark); Niro Atomizer A/S, Soeborg (Denmark). Feb 1989. (In Danish). In *Deformation and frost-resistant characteristics of desulfurization products.* Order Number DE89902273/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Energiministeriets Energiforskningsprogram. Miljoe og restprodukter.; EFP-83.

To investigate the frost susceptibility of desulphurization products, and experimental set-up has been developed. This consists of a rectangular sample with dimensions 80 x 70 x 30 cm, positioned in a controlled temperature field between two heat reservoirs. The heat reservoirs are connected with two automatically controlled cooling baths with an effective temperature range between -15 and +30 deg. C. Insulation assures a uniform temperature gradient through the sample, with no significant side friction effects. The arrangement is equipped with displacement transducers for measurement of any frost heaves that develop. Temperature variations within the sample are monitored by two series of thermo-elements with electronic data logging. With the use of this apparatus, hardened, compacted desulphurization product, as well as pelletized samples have been examined through long-term freezing experiments. Detailed results and graphic analysis are presented and evaluated. Unsaturated samples with no addition of water show no frost heaving. With addition and absorptions of water, hardened desulphurization product must be considered low to moderately frost susceptible, with a freezing rate of 2 mm/24 hr and greater than 20 mm of heaving after 250 hours freezing. Pellets can be considered as non-frost susceptible after international criteria. (author).

41466 (OH/RD–88-132-K) **Lambton TGS [thermal generating station] ash storage area. Future operation guidelines.** Cragg, C.B.H. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 18p. (MICROLOG–89-02553). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Guidelines for operating the Lambton ash storage area over the six year period 1988-1993 are presented. These guidelines are provided as a means of achieving a final design profile for the storage area while controlling fugitive dust emissions from the site. Shaping of containment berms, capping of inactive fill areas, minimizing the area of active ash filling, regular inspection, and standby dust control equipment are key elements in this plan. 10 refs., 10 figs.

41467 (ORNL/FTR–3334) **Radioactive waste management and waste product utilization, Karlsruhe and Julich, FRG, Trondheim, Norway, Forsmark and Nykoping, Sweden, Vantaa, Lovisa, and Helsinki, Finland, and Leningrad, USSR, June 12-July 16, 1989: Foreign trip report.** McDaniel, E.W. Oak Ridge National Lab., TN (USA). 31 Jul 1989. 33p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015414/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler presented a paper at the Third International Conference on the Use of Fly Ash, Silica Fume, Slag, & Natural Pozzolans in Concrete in Trondheim, Norway, on June 18–23, 1989. After the Norway meeting, the traveler visited nuclear facilities in Sweden and Finland and the Khlopin Radium Institute in Leningrad, USSR. The KFK facility in Karlsruhe, FRG, was visited prior to the Norway conference.

41468 (PB–89-194187/XAB) **Experimental study of high levels of SO_2 removal in atmospheric-pressure fluidized-bed combustors. Report for October 1978-July 1980 (Final).** Kinzler, D.D.; Drake, K.R. FluiDyne Engineering Corp., Minneapolis, MN (USA). Apr 1989. 144p. Available from NTIS, PC A07/MF A01.

The report describes tests (conducted in an atmospheric-pressure fluidized-bed combustor (FBC) with a cross-section of 1 x 1.6 m) to demonstrate high levels of SO_2 removal when burning a high-sulfur coal and feeding limestone sorbent for SO_2 removal. The goal was to achieve 90-plus % SO_2 removals with reasonable sorbent feed rates through suitable reductions in sorbent particle size (to improve reaction kinetics) and increases in gas residence time (to increase gas/sorbent contact time), in a manner predicted by an existing mathematical model. The result supports model predictions. Reducing sorbent particle size and increasing gas residence time resulted in modest increases in SO2 removal over the range of conditions tested here. Increases in flue-gas O_2 content also increased removals. Only one of the three sorbents considered for the project had the attrition resistance necessary to permit use in the testing, indicating that some sorbents will not be suitable for use in dense-phase FBC. NOx emissions ranged from 130 to 236 ng/J during these tests.

41469 (PB–89-863575/XAB) **Acid mine drainage. October 1978-May 1989 (Citations from the NTIS data base). Report for October 1978-May 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 125p. Available from NTISPC N01/MF N01.

Supersedes PB–88-865019.

This bibliography contains citations concerning laboratory and field analyses of acid mine drainage. Topics include site investigations and characterization, renovation and monitoring programs, contaminant treatment research, and control and abatement studies. Chemical analyses of affected areas, and terrestrial and aquatic ecosystems response evaluations are also discussed. (This updated bibliography contains 209 citations, 19 of which are new entries to the previous edition.)

0109 Environmental Aspects

Refer also to citation(s) 41446, 41492, 41493, 41921, 41927, 41928, 44028

41470 (CRIEPI-T–87106) **Transport of solutes from coal ash through soil.** Sato, K. Central Research Inst. of Electric Power Industry, Tokyo (Japan). 1989. vp. (In Japanese).

In order to estimate the movement of solutes leached from the coal ash in soil, solute transport models have been developed through laboratory experiments. Each model is composed of a one-dimensional convective-dispersive equation and an adsorption equation. Most coal ashes from coal-fired power plants in Japan produce strongly alkaline leachates. This alkalinity is expected to be neutralized by the underlying, unsaturated soil layer during the infiltration of leachate. The models estimate the effect of pH of interstitial water on the adsorption of solutes by soil. The movement of solutes in alkaline leachates in neutral soil layers has been examined through soil-column experiments, and the results have been analyzed using the models. The main results are as follows: (1) Changes in pH of interstitial water due to the neutralization of alkaline leachate by soil did not cause changes in the infiltration velocity of boron and sulfate through soil, because they moved through the neutral soil layer extremely rapidly compared to that of alkaline leachate front. (2) The molybdenum concentration of the effluent from soil-columns exceeded that of the input leachate when the alkaline leachate front reached the bottom of the columns. This phenomenon can be explained by the strong adsorption of molybdenum by neutral soil and the weak adsorption by alkaline soil. Thus the molybdenum adsorbed by neutral soil was desorbed when the alkaline leachate front moved downward. (3) The models predicted the same phenomenon also for chromium (VI), but the chromium concentration of effluent did not increase when the alkaline leachate front reached the bottom of the columns. This result suggests that reduction of chromium (VI) to chromium (III) occurred when chromium (VI) moved through soil.

41471 (EC–8310) **OECD round table on coal and the environment.** Environment Canada, Ottawa, ON (Canada). 1983. 65p. Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1.

This document was prepared as a discussion paper for a 1983 OECD round table on coal and the environment. Background information is provided on Canada's coal development history and future. The extent and distribution of Canada's coal resources and reserves are examined, and production capability and market factors are discussed within the context of Canada's regional diversity. The major environmental issues related to coal are then addressed. Unresolved problems include long-range transport of airborne pollutants, trace element emissions, water availability and quality, health and safety, community impacts, and carbon dioxide loading. Finally, options are presented for resolving conflicts between the use of coal and the quality of the environment. Regulatory, technical and advocacy approaches are discussed. The importance of advocacy and institutional liaison as a component of Canada's approach in this area is noted. 9 figs., 7 tabs.

41472 (INIS-mf–11989, pp. 223) **Study on environmental pollution associated with coal fly-ash using INAA.** Rausch, H. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics); Sziklai, I.L.; Zemplen-Papp, E. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

0110 Reserves and Exploration

Refer also to citation(s) 41471, 41593

0120 Mining

Refer also to citation(s) 41482, 41622

41473 (PB–89-168967/XAB) **Mine maintenance-material handling: Volume 1. Final technical report. Mining research contract report.** Conway, E.J.; Elliott, W.A.; Unger, R. Canyon Research Group, Inc., Westlake Village, CA (USA). May 1988. 45p. (REPT–10-3095-VOL-1). Available from NTIS, PC A03/MF A01.

See also Volume 2, PB–89-168975.

This report describes background research and concept development on a project intended to design, construct, and evaluate devices to reduce the injury risk and manual effort associated with the handling of maintenance materials in underground coal mines. Project activities included a review of literature, previous research programs, and accident statistics; visits to mines for study and data collection; data analysis and specification development; and concept generation and evaluation. Five prototype manual material-handling devices were then designed, fabricated, and transported to operating coal mines for field evaluation.

41474 (PB–89-168975/XAB) **Mine maintenance-material handling: Volume 2. Prototype device specifications. Mining research contract report.** Conway, E.J.; Elliott, W.A.; Unger, R. Canyon Research Group, Inc., Westlake Village, CA (USA). May 1988. 52p. (REPT–10-3095-VOL-2). Available from NTIS, PC A04/MF A01.

See also Volume 1, PB–89-168967.

This report describes background research and concept development on a project intended to design, construct, and evaluate devices to reduce the injury risk and manual effort associated with the handling of maintenance materials in underground coal mines. Project activities included a review of literature, previous research programs, and accident statistics; visits to mines for study and data collection; data analysis and specification development; and concept generation and evaluation. Five prototype manual material-handling devices were then designed, fabricated, and transported to operating coal mines for field evaluation.

41475 (PB–89-177315/XAB) **Measurement of underground lightning-induced surges in a colliery.** Geldenhuys, H.J. Council for Scientific and Industrial Research, Pretoria (South Africa). National Electrical Engineering Research Inst. 1987. 18p. (CSIR-R-ELEK–407). Available from NTIS, PC EE04/MF E04.

See also PB–89-177364; North American Continent sales only.

This paper describes the layout and construction of a station for the measurement of lightning-induced surges in typical detonator circuits in collieries. Some results are given, and the implication of the results to different types of detonators are discussed.

41476 (PB–89-177364/XAB) **Design and use of simple fuse surge detectors to evaluate the occurrence of electrical lightning-induced surges underground in collieries.** Geldenhuys, H.J.; Kinghorn, J.M.; le Roux, H.R.; Zeh, Z.A. Council for Scientific and Industrial Research, Pretoria (South Africa). National Electrical Engineering Research Inst. 1987. 14p. (CSIR-R-ELEK–413). Available from NTIS, PC EE04/MF E04.

See also PB–89-177315; North American Continent sales only.

This paper describes the design, construction, and implementation of fuse surge detectors (FSD). FSD are used to determine the frequency at which surges occur underground in typical electric-detonator circuits. A theoretical model is also presented, and the measured and predicted results are compared.

0130 Transport and Handling

Refer also to citation(s) 41452, 41502

41477 (CONF-880765–2) **Velocity measurements of transparent non-Newtonian pipeline slurries with laser Doppler anemometry.** Park, J.T.; Mannheimer, R.J.; Grimley, T.A.; Morrow, T.B. Southwest Research Inst., San Antonio, TX (USA). [1988]. 7p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-86PC90962. From 4. international symposium on applications of laser anemometry to fluid mechanics; 11-14 Jul 1988. Order Number DE89016322/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

An experimental description of the flow structure of non-Newtonian slurries in the laminar, transitional, and full turbulent pipe flow regimes was the primary objective of this research. Measurements included rheological characterization of the fluid and local fluid velocity measurements with a 2-component laser Doppler anemometer (LDA). Optical access to the flow was gained through a test section and a non-Newtonian slurry which were both transparent. Experiments were conducted in a large-scale pipe slurry flow facility with an inside pipe diameter of 51 mm. 12 refs., 12 figs., 1 tab.

41478 (DOE/PC/88947–T3) **Development and utilization of new diagnostics for dense-phase pneumatic transport: Quarterly technical progress report, April 1–June 30, 1989.** Louge, M.Y.; Jenkins, J.T. Cornell Univ., Ithaca, NY (USA). 1989. 9p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88947. Order Number DE89016628/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The main objective of this work is to develop probes for local measurements of solid velocity and holdup in dense gas-solid flows. In this context, capacitance probes are designed to measure local time-dependent particle concentrations. In addition, a new optical fiber probe based on laser-induced-phosphorescence is developed to measure particle velocities. The principles for the capacitance and optical diagnostics were given in our first and second quarterly reports. In this period, our experimental study of the effective dielectric constant of particle-fluid mixtures has led us to consider conductive metal particles. For these particles, we have found that sphericity plays an important role, and that a self-consistent model for spheroids can fit the data with reasonable accuracy. In the development of the anemometer probe, we have setup a new optical laboratory remotely linked to our pulsed-dye laser by an optical fiber. Finally, we have begun to address the question of modeling dense-phase pneumatic transport by carrying out a critical review of the available literature. In this context, we have opted for a design of a dense-phase pneumatic system that permits the transport of single plugs of material. 4 refs., 5 figs.

41479 (DOE/PC/89864–T1) **Comparison of erosion resistance of solids-handling pumps: Combined first and second quarterly progress report, February 9, 1989–June 30, 1989.** Hauserman, W.B. North Dakota Univ., Grand Forks, ND (USA). Energy and Mineral Research Center. 21 Jul 1989. 35p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-89PC89864. Order Number DE89016443/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Burly pump is a semi-open-impeller centrifugal, designed to handle slurries or suspensions of course solids, sustaining minimal erosive damage to the impeller. The primary objectives of this project are to evaluate quantitatively the degree of erosion resistance of the open-impeller Burly pump, or pumping of highly loaded, erosive slurries, to analyze and explain any unique aspects of its performance, to provide standard hydraulic performance data, and to assist the manufacturer in further testing and design development. Evaluation of erosion rates is to be done by circulating a highly erosive quartz slurry in pumps in which normal, cast iron impellers have been replaced by epoxy castings, accelerating by orders of magnitude the rate of erosive damage that would be incurred during normal operation. 5 refs., 4 figs.

41480 (DOE/PC/90518–T8) **Aerated and vibrated chute feeders for particulate materials: Quarterly technical report, March 1, 1989–May 31, 1989.** Jackson, R.; Nott, P.R. Princeton Univ., NJ (USA). Dept. of Chemical Engineering. 1989. 4p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-86PC90518. Order Number DE89016093/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have been continuing our project of investigating the flow of granular materials under shear with applications to aerated and vibrated chute feeders. We have proposed a theory for the rheology of flowing particulate materials and have applied it to the problem of aerated and vibrated chute flow. The results of this theoretical analysis have been detailed in our previous reports. We are currently engaged in conducting experiments of aerated chute flows and will soon be in a position to measure the effect of aeration on the performance of our chute. 3 refs., 3 figs.

41481 (DOE/PC/90962–T10) **Experiments on densely-loaded non-Newtonian slurries in laminar and turbulent pipe flows: Final report.** Park, J.T.; Mannheimer, R.J.; Grimley, T.A.; Morrow, T.B. Southwest Research Inst., San Antonio, TX (USA). Jun 1989. 37p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-86PC90962. Order Number DE89016390/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An experimental description of the flow structure of non-Newtonian slurries in the laminar, transitional, and fully-developed turbulent pipe flow regimes was the primary objective of this research. Experiments were conducted in a large-scale pipe slurry flow facility with an inside diameter of 51 mm (2 inches). Approximately, 550 liters (145 gal) of slurry were necessary in the operation of the loop. Detailed velocity profile measurements by a two-color, two-component laser Doppler anemometer (LDA) were accomplished in a transparent test section with an optically transparent slurry. These velocity measurements were apparently the first ever reported for a non-Newtonian slurry with a yield value. The transparent slurry was formulated for these experiments from silica with a particle size of one to two microns, mineral oil, and Stoddard solvent. From linear regression analysis of concentric-cylinder viscometer data, the slurry exhibited yield-power-law behavior with a yield stress of 100 dynes/cm^2, and an exponent of 0.630 for a solids concentration of 5.65% by weight. Good agreement was attained with rheological data derived from the pressure drop data in the flow loop under laminar flow conditions. The rheological properties of the transparent slurry were similar to many industrial slurries, including coal slurries, which have a yield value. 27 refs., 17 figs.

41482 (EUR–12063-FR) **Investigation of product size consist.** Commission of the European Communities, Luxembourg (Luxembourg). 1989. 68p. (In French). Available from Commission of the European Communities, Luxembourg.

This investigation deals with the size degradation of coal during winning and transport underground, preparation and washing and finally surface handling. Unlike previous investigations, which are given in reference, the research work concentrated on the complete coal-handling chain and included the entire range of coals from low-volatile to high-volatile grades. The report describes the laboratory tests and interprets the findings, demonstrating the benefits to be gained from carrying out this work in a systematic manner - particularly at the point of use - before the final handling stages prior to coal utilisation. On the other hand, size-consist measurement programmes at the beginning of the coal handling chain do not seem justified as long as the 'inevitable' breakage does not happen. All these conclusions are discussed in this final report and are modulated in accordance with the concerns of the reader and with the type of coal being investigated.

0140 Combustion

Refer also to citation(s) 41911, 41912, 41925, 42504

41483 (CRIEPI-EW–87001) **Development of ultra high temperature gas turbine combustor thermally protected by ceramic tiles.** Abe, T.; Hisamatsu, T. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Jul 1987. 54p.

The report deals with the enlargement of ceramics inlaid high-temperature combustor, and describes the structural improvements to be made as a result of enlargement, study on designing appropriate air distribution in a combustor using water stream model, and results of combustion tests on the experimental combustor models.

41484 (CRIEPI-EW–87003) **Methods for predicting NO_x emissions in coal combustion and unburned carbon in fly ash - effects of coal properties.** Nakata, T.; Sato, M.; Makino, H.; Ninomiya, T. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Feb 1988. 30p. Available from Central Research Inst. of Electric Power Industry, Tokyo (Japan).

In this study, combustion experiments on twenty-eight types of coal were conducted in order to examine the methods for predicting NOx and unburned carbon emission from coal properties. This experiment clarified the following points: (1) the conversion ratio of nitrogen in coal to NOx can be accurately predicted with a linear function by computing the ratio of coal nitrogen content to fuel ratio; (2) the same predictive formula proposed can be applied to find out the unburned carbon concentration in fly ash for many types of coal. Based on the above premises, the methods were devised for predicting NOx and unburned carbon emission in pulverized coal combustion with high accuracy for many coal types with a variety of coal properties.

41485 (DOE/MC/21353–2663) **A model of erosion in fluidized beds developed using kinetic theory for granular flows: Topical report.** Rogers, W.A. EG and G Washington Analytical Services Center, Inc., Morgantown, WV (USA). Jan 1989. 50p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-85MC21353. Order Number DE89000939/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

An analytical erosion model is developed by using the kinetic theory of gases extended to granular media in combination with Finnie's single-particle erosion model for ductile surfaces. The erosion expression will predict erosion values for submerged surfaces in fluidized beds using hydrodynamic data calculated from a two-phase computer code. A discussion and evaluation of the behavior of the erosion model for various types of particle-wall interactions is presented. Assumptions and limitations inherent in the model are also discussed. The erosion model requires average granular phase velocity gradients that will be provided by a transient, two-phase flow numerical code called FLUFIX. FLUFIX provides an Eulerian history of voidage, particle velocity, fluid velocity, and pressure fields within a fluidized bed. The hydrodynamic model on which FLUFIX is based is described as well as details on the incorporation of FLUFIX-generated data into the erosion model. 32 refs., 5 figs.

41486 (DOE/PC/88859–T4) **Formation and destruction of nitrogen oxides in coal combustion: Sixth quarterly report, April 1, 1989–June 30, 1989.** Chen, Wei-Yin; Lester, T.W.; Babcock, L.M.; Burch, T.E.; Tillman, F.R. Louisiana State Univ., Baton Rouge, LA (USA). Jul 1989. 27p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88859. Order Number DE89016627/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Nitrogen oxide reduction and formation mechanisms in reburning are investigated with a laboratory scale flow reactor. Feed to the reactor includes simulated flue gas and reburning fuels (methane, benzene and hexane). The yields of individual nitrogenous species depend strongly on temperature, second stage stoichiometry (SR2) and reburning fuel type. Although the optimum NO yield takes place at SR2 values between 0.9 and 0.95, the optimum total fixed nitrogen (TFN) yield seems to occur at about 0.95. Among the three fuels studied, heavier fuels tend to reduce NO to HCN more effectively. Reduction NO to HCN by reburning with methane is very sensitive to temperatures at about 1050°C. Reburning with long chain paraffins (such as hexane) seems to be very effective at lower temperatures. A unique GC/MS analytical method has been established for the systematic analysis of flue gas. This convenient method is expected to benefit combustion researchers who need quick, repeated analysis of flue gas. A chemical kinetics code, CHEMKIN, and the newest C_1 and C_2 reaction set are used to calculate product yields in $NO/CH_4/CO_2/O_2/He$ systems. The model is fairly successful in predicting TFN and the three nitrogenous species, particularly the NO yields. The model slightly under estimates the NH_3, and over predicts HCN yields at low SR2 conditions. The yields of all nitrogenous species are higher than their equilibrium concentrations, as calculated by NASA's equilibrium code. 7 refs., 15 figs., 1 tab.

41487 (DOE/PC/88918–2) **Reduction of NO_x and SO_2 emissions from coal burning pulse combustors: Quarterly technical progress report, January 1, 1989–March 31, 1989.** Powell, E.A.; Zinn, B.T. Georgia Inst. of Tech., Atlanta, GA (USA). School of Aerospace Engineering. Apr 1989. 12p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88918. Order Number DE89015753/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Work accomplished during the second quarter is presented and discussed. This project is concerned with the reduction of the nitrogen oxides and sulfur dioxide emissions from Rijke type pulse combustors by using combustion staging and limestone addition. Most of the work accomplished during this period was concerned with the design and fabrication of several auxiliary systems needed for operation of the Rijke combustor. These include the coal feed system, the limestone feed system, the coal bed, the bed temperature control system, and the ignition and preheating system. Each of these systems is described in the report. 8 figs.

41488 (STEV-FBT–89-1) **Thermal behavior of slumped zones in fluidized bed combustors.** Andersson, S.; Leckner, B. Statens Energiverk, Stockholm (Sweden). 1989. 11p. (CONF-850302–4: 8. international conference on fluidized bed combustion, Houston, TX (USA), 18-21 Mar 1985). Order Number DE89902387/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Partial defluidization of a fluidized bed is employed to change the load of a fluidized bed boiler. Due to leakage of gas containing oxygen from the fluidized part of the bed into the defluidized part, combustion of the remaining fuel may cause the temperature in the defluidized part of the bed to rise. If the temperature rises too much, the bed material sinters and a restart of the defluidized zone will be impossible. In order to understand how such a temperature rise occurs and how to avoid it, a mathematical model is developed. The model consists of flow, energy, and concentration equations for the gas and the solid material in the defluidized zone. The model give the corresponding fields in the defluidized zone at various input conditions. The calculated results from the model are compared with measurements made in the 16 MW AFBC boiler at Chalmers University of Technology.

41489 (STEV-FBT–89-3) **Operation of the Canadian FBC model.** Lyngfelt, A. Statens Energiverk, Stockholm (Sweden). 1989. 37p. (CONF-8605365–1: IEA AFBC workshop on FBC mathematical modelling, Vienna (Austria), 5 May 1986). Order Number DE89902386/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A computer simulation for fluidized bed coal combustion has been distributed to the participant of the IEA cooperation on atmospheric fluidized coal combustion. The computer program was program was developed by Ferdinand Preto at Queen's University, Kingston, Canada. This report gives the experiences of operating this program. The evaluation of the program is carried out mainly as a parameter study. The aim of this study is to investigate the usefulness of the program for an 'ignorant' user, i.e. to test it by running it. Carbon monoxide is more sensitive than sulphur dioxide and nitrogen oxide to changes input data. Important factors are the oxygen content in the upper part of the emulsion phase, the particles in the freeboard and the residence time. NO_x/N-fuel does not vary more than 25% at most, and usually much less. Carbon efficiency is in most cases very high, more than 99%. The only factors that can lower these values seem to be those which affect coal particle residence time, i.e. fluidization velocity, cyclone efficiency and coal particle size. Combustion efficiencies are affected significantly only for very small coal particle sizes. Limestone efficiency shows a dependence on bed temperature and a slight dependence on excess air ratio, and bed height. Otherwise any dependences are negligible. The temperature in all runs was high, which can partly explain the small dependences observed.

41490 (STEV-FBT–89-13) **Primary measure to reduce the emissions of nitrogen oxide in circulating fluidized bed boilers.** Leckner, B.; Aamand, L.E. Statens Energiverk, Stockholm (Sweden). 1987. 16p. (CONF-8709455–1: Swedish Flame Days conference, Studvik (Sweden), 8-9 Sep 1987). Order Number DE89902388/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The paper gives a summary of results obtained in a series of test on a 40 MW circulating fluidized bed boiler in Nykoeping, designed by Goetaverken Energy. In this commercial boiler it was not possible to study the influence of primary to secondary air addition independent of the bed temperature. For this reason, a smaller boiler designed by the same manufacturer was adapted to permit independent variations of the primary air ratio and the bed temperature. The results from the 40 MW and the 8 MW boilers are compared and the influence of the distribution of the air supply and of the bed temperature on the reduction of nitrogen oxide emissions are discussed.

41491 (UCRL–21163) **Tubing wastage in fluidized-bed coal combustors (TVA, 20 megawatt AFBC Pilot Plant).** Witherell, C.E. Lawrence Livermore National Lab., CA (USA). 7 Apr 1989. 58p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-48. Order Number DE89016653/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Study of TVA tubing samples representing both wastage-susceptible and wastage-resistant tube banks has indicated a wastage mechanism similar to that identified in previously-studied tube samples from Grimethorpe (UK). Metallurgical differences between the two TVA tube banks were also observed that are believed relevant to their wastage response. Wastage appears to occur through exfoliation of protective oxide scale caused by impingement and abrasion of fluidized bed materials. There is no evidence that chemical effects of elements such as sulfur or chlorine are responsible for or contribute to the wastage process. The tube from the wastage-resistant tube bank, in contrast to the tubes that experienced wastage, formed an alloy-enriched layer at the scale/substrate interface that is apparently oxidation resistant and seems to protect the steel surface from mechanical impacts and abrasion of bed materials. 47 refs., 22 figs., 2 tabs.

41492 Status of Clean Coal Technology Demonstration projects at the Pittsburgh Energy Technology Center. Strakey, J.P. (Clean Coal Technology Task Force, Pittsburgh Energy Technology Center, U.S. Dept. of Energy, Pittsburgh, PA (US)); Santore, R.R. vp. of Energy technology XVI. Government Institutes Inc., Rockville, MD (1989). (CONF-890213–: 16. annual energy technology conference, 28 Feb - 2 mar 1989).

The Clean Coal Technology Demonstration projects differ in several important respects from those conducted under DOE's more traditional Fossil Energy R and D programs. These R and D programs have centered on the long-range, high-risk, high-payoff research that industry is unlikely to undertake independently. Generally, DOE provides most or all of the funding for this research. Clean Coal Technology projects, by contrast, seek to demonstrate the commercial feasibility of the best and most promising of the array of advanced clean coal concepts that have already reached the proof-of-concept stage. These projects are conducted under jointly funded cooperative agreements - not contracts - between government and industry.

41493 Status of clean coal technology projects at the Morgantown Energy Technology Center. Salvador, L.A. (Clean Coal Projects Div., United States Dept. of Energy, Morgantown Energy Technology Center (US)). vp. of Energy technology XVI. Government Institutes Inc., Rockville, MD (1989). (CONF-890213–: 16. annual energy technology conference, 28 Feb - 2 mar 1989).

The United States Department of Energy (DOE) and its predecessor organizations, the Office of Coal Research, the Bureau of Mines, and the Energy Research and Development Administration (ERDA) have, for many years, fostered the research and development (R and D) of technologies which would enable the United States to utilize its vast coal resources in a clean and efficient manner. These development programs were chartered to promote domestic industry, provide for national security, protect the environment, help balance foreign imports with United States exports, and meet the growing energy needs of the country. In the last 15 years, this R and D effort has been accelerated as a result of the rising concern over the increasing dependence on foreign petroleum.

41494 Overview of the Department of Energy's advanced combustion program. Ruth, L.A. (U.S. Dept. of Energy, Pittsburgh Energy Technology Center, Pittsburgh, PA (US)); Winslow, J.C.; Gyorke, D.F.; Mayne, A.E. vp. of Energy technology XVI. Government Institutes Inc., Rockville, MD (1989). (CONF-890213–: 16. annual energy technology conference, 28 Feb - 2 mar 1989).

A major goal of the Office of Fossil Energy (OFE) of the U.S. Dept. of Energy (DOE) is to expand coal's contribution to the nation's energy mix by improving the environmental, technical, and economic performance of coal-based systems, thereby increasing their flexibility and applicability. This goal is being achieved by conducting R and D aimed at expanding the scientific and engineering knowledge base necessary for coal use so that industry can bring economically competitive and environmentally acceptable coal utilization technologies into the marketplace. Research is conducted in those areas not primarily pursued by the private sector because of unacceptably high risk and/or little potential for short-term payback of the R and D investment.

41495 Small scale CWF combustor development. Balsavich, J.C. (Tecogen Inc., Waltham, MA (US)); Becker, F.E.; Smolensky, L.A. vp. of Energy technology XVI. Government Institutes Inc., Rockville, MD (1989). (CONF-890213–: 16. annual energy technology conference, 28 Feb - 2 mar 1989).

Under a contract with the U.S. Dept. of Energy, Pittsburgh Energy Technology Center (PETC), Tecogen Inc., is developing a Coal Water Slurry (CWS) fueled, residential, warm-air heating system. The overall objective of the research program is to develop an economically viable, CWS-fired residential warm-air furnace competitive in size, performance, reliability, and ease of operation with respect to present oil- and gas-fired systems. The intended system is to be modular in design and suitable for use in both forced-hot-air and hydronic systems. The system includes a novel 100,000-Btu/hr input rated, non-slagging combustor for which a patent (DOE Case S-67.354) for the concept is being executed by the U.S. DOE Office of Patent Counsel. The combustor, which can be generally described as an Inertial Reactor with Internal Separation or IRIS, has demonstrated high combustion efficiencies of over 99 percent using coal water slurry fuels, without the need for preheated air or fine fuel atomization. The combustor operates in a basically non-slagging mode, which enables rapid startup (less than 5 minutes to full fire) and shutdown.

41496 Performance of materials in fluidized-bed combustors. Natesan, K. (Argonne National Laboratory, IL (USA)); Miller, S.A.; Podolski, W.F. *Journal of Materials Engineering (USA)*, 9(3): 269-282 (1987).

The major materials issue in the commercialization of fluidized-bed combustion (FBC) systems for utility cogeneration applications is the corrosion/erosion degradation of in-bed components. To examine this issue, pertinent materials information was collected from 13 sources that included different experimental fluidized-bed combustors (four pressurized, the others atmospheric), and a detailed analysis of the data was performed. The data analysis confirmed that austenitic stainless steels (notably Types 304 and 310) and cobalt base alloys (notably Haynes 188) are superior to nickel-base alloys. Type 347 stainless steel and Incoloy 800 H are questionable from the point of view of metal wastage. Very limited data are available for claddings and coatings. The correlations of the corrosion rate data presented in this paper for several of the more promising alloy candidates for air heater applications provide guidelines for the selection of materials with reasonably assured performance in a corrosive environment. 42 refs., 19 figs., 1 tab.

41497 In situ Raman spectroscopy of high temperature pyrite reactions related to deposit formation from coal. McCarty, K.F. (Sandia National Laboratories, Livermore, CA (USA). Combustion Research Facility); Hamilton, J.C.; Boehme, D.R.; Nagelberg, A.S. *Journal of the Electrochemical Society (USA)*, 136(4): 1223-1229 (Apr 1989).

A major fraction of sulfur impurities in common coal occurs as iron pyrite and marcasite (FeS_2). These compounds are important sources of the iron and sulfur which occur in deposits formed in coal burning systems. High temperature pyrite reactions related to deposit formation were studied in furnace and flame environments using in situ Raman spectroscopy. Rapid oxidation of FeS_2 to α-Fe_2O_3 and resulfidation of α-Fe_2O_3 to FeS_2 were observed in a

furnace using Raman and thermogravimetric analysis. Deposit formation on inert substrates immersed in the exhaust gases of pyrite-seeded flames was studied in real time using Raman spectroscopy complemented by postexposure examination of the deposits. Deposit composition showed a strong dependence upon flame stoichiometry, with α-Fe_2O_3 being formed from oxygen-rich flames. Another common fuel impurity is sodium and the addition of sodium formate to the pyrite seed caused compounds containing sulfate and sodium ferrate to appear in the deposits. Since the sodium and iron of sodium ferrate arise from two different sources (sodium formate and iron pyrite, respectively), sodium ferrate is formed from reactions involving the combustion products of both seed materials. 7 refs., 12 figs.

0160 Health and Safety

Refer also to citation(s) 41475, 41476

41498 (CRIEPI-U–88036) **Accumulation of alveolar macrophages in alveoli after exposure to coal fly ash.** Negishi, T. (and others). Central Research Inst. of Electric Power Industry, Tokyo (Japan). 1989. vp. (In Japanese).

This study was carried out to clarify the possible mechanisms of cluster formation of alveolar macrophages (AMs) in alveoli after long-term exposure to coal fly ash particles. It was suggested that AMs accumulation might occur because they became sluggish and lost their migration ability after phagocytizing a large number of deposited particles. It was also suggested that in the beginning of cluster formation, both cluster-forming AMs and newly emigrating AMs phagocytized deposited particles, and that after long-term exposure polymorphonuclear leukocytes also ingested and cleared particles in alveoli.

41499 (ETDE-mf–9795634) **Systems for locating buried persons. Final report.** Fischer, D.; Stiehl-Wolf, A. Versuchsgrubengesellschaft m.b.H., Dortmund (Germany, F.R.). Sep 1988. 62p. (In German). Order Number DE89795634/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A04/MF A01.

Rescue methods of the most varied kinds were first considered theoretically and the most promising were then tested in the experimental mine in order to find methods which would efficiently shorten and make easier the search for a buried miner in an emergency situation. It turned out that listening devices, search dogs, avalanche rescue equipment and developmental proposals for location systems from the USA are not to be recommended, on the grounds of limited applicability or even lack of locating capacity. Up till now only two systems or methods have been found useful in locating a buried miner. They are: 1. The GLON/LOP system, a new development of the Headquarters of the Mine Rescue System in Bytom/Poland, in cooperation with the Technical Military Academy in Warsaw, and 2. The SERLES system, a development of Dr. Norbert Nessler of the University of Innsbruck in Austria. Both systems are capable of determining the location of a transmitter at a distance of 20 m with a precision of 0.5 to 1 m deviation. Adverse conditions (steel reinforcement, electric cable, tracks, water etc.) and reduced or unknown transmitter performance caused no serious restriction. Any distortions that occurred in individual measurements could be recognized and corrected. (orig./HS).

41500 (PB–89-170690/XAB) **Epidemiological and clinical studies of back pain in the mining industry. Final report.** Agius, R.M.; Lloyd, M.H.; Campbell, S.J.; Graveling, R.A.; Hutchison, P.A. Institute of Occupational Medicine, Edinburgh (UK). Nov 1988. 190p. (TM–88/10). Available from NTIS, PC EE09/MF E09.

Epidemiological, clinical, and ergonomic studies of back pain in the mining industry are described. The aims of the studies were to determine whether the prevalence of back pain among the miners was higher than among a control group of workers, whether back pain was associated with particular named occupations or work areas in mining, whether certain characteristics of the individuals may be associated with increased susceptibility to back pain and what relationship existed between postures and movements and the incidence of back pain. The study suggested differences in the frequency of back pain, between mine workers and a control population engaged in less physical work. However, this difference was significant only beyond the age of 40 and could have been influenced by low response bias.

41501 (PB–89-170708/XAB) **Working in hot conditions in mining: a literature review. Final report.** Graveling, R.A.; Morris, L.A.; Graves, R.J. Institute of Occupational Medicine, Edinburgh (UK). Oct 1988. 125p. (TM–88/13). Available from NTIS, PC EE07/MF E07.

This review includes a brief overview of thermal physiology: environmental and metabolic heat loads and the physiological and behavioral responses to such loads. It also encompasses methods for the assessment of hot conditions either directly, through the measurement of physiological strain, or indirectly via thermal indices. These elements are then examined in the context of UK mining conditions with sections on the thermal and metabolic heat loads reported in coal and potash mines and an assessment of those thermal indices that suitably reflect the potential effects of such loadings. Also, the review examines various control measures such as refrigeration and personal cooling for their potential impact on the work force. It concludes that many of those currently employed have some merit although many can have undesirable 'side-effects.' For example, local cooling can create problems elsewhere underground where the extracted heat is discharged.

41502 (PB–89-175350/XAB) **Suggested rapid method for the determination of the liability to spontaneous combustion of coal. Special report.** Coetzee, S.D. National Inst. for Coal Research, Pretoria (South Africa). 1987. 18p. Available from NTIS, PC EE04/MF E04.

North American Continent sales only.

It has long been known that of the piles of coal awaiting shipment at the coast, the pile and the point at which spontaneous heating is most likely to commence will be the pile and surface exposed to the windward side of the piles. Spontaneous heating occurs in a milieu in which there is a regular variation in the conditions in which dry and moist air enter into the coal alternately or dry air and moisture from the inert atmosphere, which exists within the deeper or inner part of the pile, alternates. By alternately drying and wetting coal in the laboratory simulation, significant changes were found in the mass of the dry coal. These are ascribed to oxidation and hydration reactions with the liberation of carbon dioxide and water from the coal. At the same time heat arises that may cause spontaneous combustion of the coal.

41503 (PB–89-187942/XAB) **Characterization of silica in the lungs of autopsied coal miners. Final report.** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). 1989. 45p. Available from NTIS, PC A03/MF A01.

A two-part study was conducted to investigate silica in lungs of coal miners at autopsy. The prevalence of silicosis at death in coal miners in relation to mining and job categories was investigated in the first part. Lung-tissue sections submitted to the National Coal Workers Autopsy Study (NCWAS) for the period 1971 through 1980 were assessed for the presence of silicotic lesions in the pulmonary parenchyma and tracheobronchial lymph nodes. Silicosis usually occurred against a background of coal workers' pneumoconiosis; only 7.2% of lungs without coal workers' pneumoconiosis showed silicosis. Transportation workers showed the highest prevalence of silicosis, while workers primarily engaged in surface activities at underground mines have the lowest prevalence. Geographical area affected the prevalence of silicosis. The number of years spent in underground mining was found to be clearly correlated with prevalence and severity of silicosis. The second part studied the particle-size distributions and number of particles in coal miners' lungs. Particulate burdens were determined for lung specimens from 21 coal miners by scanning electron-microscope-based automated image analysis. Results were compared with those for urban dwellers. In spite of the specimens being chosen to represent a wide range of exposure and medical history, particle-size data were similar.

02 PETROLEUM

Refer also to citation(s) 41618

41504 (EMR–84-03) **Federal energy R&D. Task 6, conventional energy systems oil, gas, electricity accomplishments, 1981-1983.** Cook, B.; Van Ruskeveld, Y. Department of Energy, Mines and Resources, Ottawa, ON (Canada). 1984. 41p. (CE–02675). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

Brief description of key accomplishments of the eight National Energy Program R&D programs, on oil, gas, and electricity in the years 1981-1983 are provided. These programs are listed below. The geoscience R&D program has as its major objective, improved understanding of petroleum reservoirs and geological hazards. The Marine Engineering program was to develop means to improve the safety of marine hydrocarbon exploration and production systems through development of new technology and through industry regulation. The Offshore Geotechnics program was to improve the knowledge of seabed conditions for technological development and legislation. The Enhanced Oil Recovery Program was to develop the science of enhanced recovery applicable to Canadian light and medium gravity reserves. The Materials for Offshore Structures Program was to provide technical support such as navigational technologies and hydrographic services for the transportation of oil and gas. The Environment Program was to improve the forecasting of sea ice, and weather conditions; and to improve the understanding of environmental processes. The electrical R&D Program was to enhance the role of electricity through support of the Canadian Electrical Association and through research in transmission and measurement of electricity.

41505 (SGS–9, pp. 1-16) **New oil from old ideas. An historical review of wildcatting in frontier Saskatchewan.** Halabura, S.P. (North Rim Exploration Ltd., Cudwoth, SK, Canada). Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5. international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A preliminary study is presented of the early history of oil exploration in Saskatchewan. One of the earliest systematic exploration efforts was mounted by Imperial Oil, which had a refinery in the province. Exploration efforts from 1942 onward were plagued by problems including drilling and mud problems due to abundant anhydrite and salt, severe mechanical difficulties in perforating and cementing, and difficulties in obtaining the potential hydrocarbon-bearing zones. Imperial's program was abandoned in April 1946. Heavy oil was, however, discovered by other companies in the Lloydminster area, with commercial production starting in 1944. The next great exploration period began in 1948, and the activities of one of the major players, Sohio, are chronicled. This period was stimulated by the availability of large exploration reservations made available at low cost, and was inspired by the Leduc discovery in Alberta in 1947. Years of exploration work was done before a big strike was made from the Mississippian, and later on from the Cretaceous and Jurassic, in the southwest. The most pressing problems of the early explorers were related to the nature of salt deposits found during exploratory drilling, and to seismic correlations and interpretations. The concept of salt collapse as a mechanism for structural development, poorly understood until the mid-60s, is of interest since many structures previously considered to be barren may simply have not been drilled in the right place. It is felt that a better knowledge of the original ideas of the early explorationists, which form the basis of the present data base of the region, will help to understand the region's oil and gas potential. 18 refs., 11 figs.

0202 Geology and Exploration

Refer also to citation(s) 41620, 41628, 43683, 43684, 43685

41506 (DOE/BC/14403–1) **Characterization of oil and gas reservoir heterogeneity: Status report.** Texas Office of the Governor, Austin, TX (USA). [1989]. 4p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-89BC14403. Order Number DE89015151/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Activities under the "Characterization of Oil and Gas Reservoir Heterogeneity" project have now been initiated under the Memorandum of Understanding. The key thrust of this project is description and quantification of scales and styles of heterogeneity in restricted platform carbonates and in fluvial deltaic sandstones. These reservoir types are the most important of Texas reservoirs in terms of the remaining hydrocarbon resource base. Matching funds for the carbonate study are provided by the Bureau's industry-funded SAN ANDRES/GRAYBURG RESERVOIR CHARACTERIZATION RESEARCH LABORATORY project. Matching funds for the deltaic sandstone study are provided by a new GRI-funded initiative in reservoir characterization entitled "QUANTITATIVE FLOW UNIT AND BOUNDING ELEMENT PROPERTIES AND GEOMETRIES, FERRON SANDSTONE, UTAH: IMPLICATIONS FOR HETEROGENEITY IN GULF COAST TERTIARY DELTAIC RESERVOIRS." The current status of activities is presented.

41507 (INIS-mf–11472) **Application of nuclear techniques in the petroleum industry.** Abu Azam Md Yassin. Technology Univ. of Malaysia, Kuala Lumpur (Malaysia). 1987. 5p. (CONF-8711314–: Seminar on the application of nuclear techniques in industry, 17 Nov 1987). Order Number DE89635597/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI.

With the extremely high cost of developing Malaysian offshore petroleum resources, the foremost consideration is being placed on proper petroleum detection so as to efficiently developed the petroleum resources, and to ensure that maximum productivity is achieved. Nuclear techniques are being used to meet these requirements. The natural radioactivity of the formations is measured to determine the occurence of sandstone, which could be hydrocarbon bearing. Confirmation of types hydrocarbon presence could be achieved by bombardment of the formation with high energy neutron and measuring the subsequent gamma ray emitted. This technique also indicates the type of formation and the water saturation of the formation. Nuclear techniques are also used to diagnose the problem encountered when petroleum is produced below its potential. (author). 6 figs.

41508 (PB–89-159743/XAB) **Yukon Delta coastal processes study. Final report.** Dupre, W.R. Houston Univ., TX (USA). Dept. of Geology. Jan 1980. 51p. Available from NTIS, PC A19.

The overall objective of the study is to provide information on the depositional environments and associated geologic processes that characterize the Yukon-Kuskokwim Delta complex. The specific objectives of the study are directly related to the initial phase of selecting offshore leases. They include to: provide information on the age of faulting and volcanism; provide information on the distribution of permafrost in the region; map the depositional environments of the modern Yukon Delta; study the seasonality of coastal processes in the Norton South region, emphasizing the patterns and rates of ice movement during the winter.

41509 (PB–89-190755/XAB) **Surface-operating standards for oil and gas exploration and development 'Gold Book', (third edition).** Bureau of Land Management, Washington, DC (USA). Jan 1989. 50p. Available from NTIS, PC A03/MF A01.

Also available from Supt. of Docs.

Federally owned oil and gas resources are located on lands administered by the Bureau of Land Management (BLM), the Forest Service (FS), other Federal Surface Management Agencies (SMAs), and on lands with non-Federal surface owner (split estate lands). Federal oil/gas lease operations are managed by the BLM in cooperation with the appropriate SMA or surface owner. This brochure was developed to aid the operator in permit approval and conduct of oil and gas operations on federal lands, from exploration to development and production, to abandonment. Information is provided for preparation of the surface use and drilling programs. The brochure also will prove useful in guiding oil and gas operators on Indian lands.

41510 (SGS–9) **Proceedings of [the] fifth international Williston Basin symposium.** Carlson, C.G. (ed.); Christopher, J.E. (ed.). Saskatchewan Geological Society, Regina, SK (Canada). 1987. 280p. (CONF-8706400–: 5th international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A symposium was convened to present new information on North America's largest cratonic basin, an area of intense interest for petroleum exploration. Papers were presented in the areas of oil industry history, geologic history, stratigraphy and sedimentology, structural geology and tectonics, and various aspects of petroleum geology. Separate abstracts have been prepared for 26 papers from this symposium.

41511 (SGS–9, pp. 178-189) **Tableland photolineament pattern revisited.** Mollard, J.D. (J.D. Mollard and Associates Ltd., Regina, SK, Canada). Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5th international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.*

Distinctive lineament-and ring-patterns appear in airphotos of the landscape surrounding Home Oil's February 1986 deep oil discovery near Tableland, Saskatchewan. These patterns were in the petroleum literature over 30 years ago, and it was suggested in lasa that this pattern might reflect some type of basement structure such as a hinge line, the effect of which has been perpetuated upward into the overlying sedimentary strata. Because the area is being actively explored for major oil reservoirs in the Devonian Winnipegosis Formation, implications of the remotely sensed photolineament-and ring-patterns in petroleum exploration have taken on added significance. As a consequence, remotely sensed surface features and subsurface geological, hydro-geological, and seismic trend data are currently being synthesized and correlated. These data include near-surface preglacial, glacial and postglacial features and events that appear to be affected by deeper structure in the subsurface. Lineament block tectonics may have influenced geological events, including shoaling and reefing in the Devonian Winnipegosis, salt removal in the overlying Prairie Evaporite, and differential subsidence that has continued to the present. These interrelated geological events are thought to be responsible for the anomalous surficial lineament- and ring-patterns in the area around the Home Oil discovery well, and for their apparent areal association with reefs in the Winnipegosis Formation lying about 2650 m below ground surface. 50 refs 20 figs 1 tab

41512 (SGS–9, pp. 197-221) **Geology of the Indian Hill Field area, central Williston Basin, North Dakota. A multiple-pay field developed in the 1980s.** Mayer, J.D. (Apache Corp., Denver, CO, USA). Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5. international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Indian Hill Field area (which includes Hardscrabble Field and a portion of Camp Field) is located on a southeast plunging anticline in northwestern McKenzie County and southwestern Williams County, North Dakota. Production was established in 1978 followed by the addition of 5 shallower producing zones in the early 1980s. The productive area is about 10 miles long and up to 3.5 miles wide with production from Paleozoic carbonate reservoirs. The primary objectives are Ordovocian Red River, Silurian Stonewall, Devonian Duperow, and Mississippian Mission Canyon; and the secondary objectives are Devonian Nisku and Mississippian Ratcliffe. Productivity and reservoir development are highly variable. In general, the Red River D zone and the Duperow produce along the flanks of the structure whereas the Red River C and B zones, the Stonewall, and the better Mission Canyon produce from the crest of the structure. Cumulative production from the Mission Canyon Reservoir is about 4,833 million bbl of oil; daily production (December 1986) is 3.292 bbl/d. 35 refs., 18 figs., 3 tabs.

41513 (SGS–9, pp. 212-216) **Using capillary pressure techniques to map and identify an economic fairway in the Ordovician Red River on the western flank of the Williston Basin.** Jennings, J.B. Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5. international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Capillary pressure curves have been confined mainly to the realm of petroleum engineering but have some excellent applications in petroleum geology. The raw data are collected by injecting mercury, at increasing pressures, into plugs obrained from core or side wall samples. These measurements, when plotted, produce a curve of injection pressure versus fluid saturation from which a number of parameters can be extracted for the purposes of interpretation and mapping. Oil column heights can be calculated to define the vertical trap closure (structural or stratigraphic) required to achieve economic oil accumulations. Pore throat sorting, reservoir grade and oil column heights may be compiled and contoured to produce exploratory maps. The maps are useful for delineating oil reservoir fairway trends and highlighting areas in which to concentrate further investigative efforts. A capillary pressure study was conducted on the third porosity of the Ordovician Red River Formation. Sixteen wells with core data were sampled and mercury injection capillary pressures were obtained. Values for pore throat sorting, reservoir grade and oil column for pore throat sorting, reservoir grade and oil column requirements for 50 per cent and 75 per cent oil saturation were then plotted and contoured to produce four regional maps. Each of the four maps identified north-south trending fairway along the Montana-North Dakota border containing good example of how capillary pressure techniques can be applied to assist with exploration programs. 6 refs., 8 figs.

41514 (SGS–9, pp. 217-225) **Hydrodynamic trapping in Mission Canyon reservoirs. Elkhorn Ranch field, North Dakota.** DeMis, W.D. Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5. international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Hydrocarbons in Mission Canyon reservoirs in the Elkhorn Ranch Field area are trapped by hydrodynamic flow of waters downdip and to the northeast. The Field is located on a north-plunging anticline with only very minor crestal closures. Subtidal/strandline facies of the Mission Canyon trend south-southwest across the plunge of the structure at a very low angle, so low as to preclude trapping by stratigraphic pinch-out. Three porosity intervals of the Mission Canyon are all productive within the Field. Each has a unique distribution of oil production, but the apparent oil-water contact for each zone is tilted the same direction and amount. The configuration of structure and porosity pinch-outs (and permeability barriers defined from the core data) for these productive intervals does not provide a hydrocarbon trap. Tilt of the oil accumulation appears to be in the order of about 25 ft/mile to the northeast. Tilts of oil-water contacts determined for the Field are consistent with tilts for the Billings Nose Field. A regional map of formation water salinity shows a region of freshwaters south and southwest of the field. A regional potentiometric map shows a tilt of about 60 ft/mile to the northeast of the Elkhorn Ranch Field. The calculated tilt of the oil column is 150 ft/mile while the observed tilt is one sixth of that gradient. This discrepancy may result from the field not having reached equilibrium with the invading waters. Exploration and production geologists may be able to expand their prospects by incorporating this hydrodynamic model into their Mission Canyon play concepts. 13 figs., 12 refs., 2 tabs.

41515 (SGS–9, pp. 226-241) **Habitat of Sherwood oil, Renville Country, North Dakota.** Hendricks, M.L. (Eisel Consulting, Lafayette, CO, USA); Birge, B.P.; Eisel, J.D. Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5. international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Sherwood beds of the Mission Canyon Formation are part of an overall shallowing-upward regressive carbonate and evaporite sequence. For Sherwood depositional trends are aligned parallel to depositional strike: salina-sabkha, shoreline-lagoon, island-shoal, and open shelf. Productive lithofacies in the shoreline-lagoonal trend are peloidal and intraclastic wackestones and packstones with secondary vuggy porosity. The trap is an updip facies change to impermeable carbonates and anhydrites. Two productive lithofacies characterize the island-shoal trend: algal wackestones and packstones with fenestral and vuggy porosity, and coated-grain packstones and grainstones with interparticle and vuggy porosity. Lateral and updip traps are formed by carbonate mudstones deposited in lagoons and in very low energy, mud-dominated channels. An increase in depositional slope just basinward of the facies change from anhydrite to carbonate favored development of shoals and islands. A general thickening of Sherwood beds accompanies this break in slope. The modern Abu Dhabi coast resembles the ancient Sherwood depositional system. However, the orientation and composition of Sherwood islands differ from the Abu Dhabi islands. Sherwood production can be prolific as demonstrated by individual wells in the Sherwood Field. High production rates in the Smith Field should stimulate moreSherwood exploration along the northeast flank of the basin 15 refs., 23 figs., 1 tab.

41516 (SGS–9, pp. 242-252) **Knutson field and its relationship to the Mission Canyon oil play, south-central Williston Basin.** Bogle, R.W. (Diamond Shamrock Exploration Co.,Denver, CO, USA); Hansen, W.B. Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5. international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Knutson Field lies on the Billings-Golden Valley County line adjacent ot the western border of Theodore Roosevelt National Park. The field was discovered by Diamond Shamrock Exploration Company in 1983 with the completion of a 9325 ft. Mission Canoyon well. As of January 1, 1987, sixteen wells were producing 2583 bbl of oil and 7948 bbl of water per day, and had cumulatively made 1,993,073 and 4,374,170 bbl of water. Three factors affect accumulation of oil in the two pools of Knutson field, as well as in two Rider field wells to the south: a north plunging anticlinal nose; a trending pinchout of the Mission Canyon dolomitic reservoir; and mobile Mission Canyon ground water flowing from the southwest. Furthermore, these factors to varying degrees affect all Mission Canyon oil fields of the south-central Williston Basin. Due to the high cost of drilling and operating wells in this area, future exploration for similar reservoirs must take into account all three of the above factors. 6 refs., 14 figs., 1 tab

41517 Effects of a partially communicating fault in a composite reservoir on transient pressure testing. Ambastha, A.K. (0184000); McLeroy, P.G.; Grader, A.S. *SPE (Society of Petroleum Engineers) Formation Evaluation (USA),* 4(2): 210-218 (Jun 1989).

Many reservoirs are faulted, and hydraulic characterization of these faults for the design of field-scale developments. In addition to the effect that a fault has on fluid flow in the reservoir, it may separate two different reservoir regions with dinstinctly different properties. The detection of the properties on both sides of the fault and the distance to the fault are important in the reservoir-characterization process. In this study, a linear fault is modeled as an infinitesimal-thickness skin boundary. Analytical solutions for presure-transient behavior for a line-source, constant-rate well in a composite-reservoir are obtained with one Fourier space transformation and time-space Laplace transformations. The solutions are presented for strip and infinite reservoirs. This study examines drawdown-pressure and pressure-derivative behavior and extends and generalizes many studies presented in the past. Correlating parameters for pressure-transient responses are presented. The possibilities of boundary detections are considered, and interference pressure responses in a composite, strip reservoir are briefly discussed.

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Refer also to citation(s) 41517, 41571, 41584, 43039

41518 (AU/ME–59-65002) **Development of a chemical flooding process for light oil reservoirs in Alberta.** Farouq Ali, S.M.; Thomas, S. Alberta Univ., Edmonton, AB (Canada). Dept. of Mineral Engineering. 1983. 55p. (CE–02668). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

The construction of the laboratory facilities necessary for the development of a chemical flooding process for the light oil reservoirs in Alberta required a substantial portion of the year. Phase behavior studies on micellar solution containing Bonnie Glen crude oil plus water and Petrostep-465 were conducted to help determine the composition of an efficient and economical slug for tertiary oil recovery. A similar study was made using Bonnie Glen crude oil plus 2% brine and Petrostep-High molecular weight. A comparative study of viscosity, miscibility, and stability was made to select an optimal slug composition for tertiary recovery. This was found to be: Bonnie Glen crude oil: 55%, Petrostep-465: 30%, and water: 15% by volume. It was further found that the addition of less than 1% n-butyl alcohol can effectively control the viscosity of the solution. Since the interfacial tension between the micellar solution and water has an important bearing on enhanced oil recovery, this property was measured and was found to be 1.9377 dynes/cm. Two core displacement studies using this micellar solution to displace Bonnie Glen crude oil from Berea sandstone were completed. This showed that approximately 70% of the residual oil left behind after a waterflood secondary recovery process could be recovered using a 5% pore volume slug. 22 figs., 6 tabs.

41519 (DOE/BC/14126–8, pp. 2-24) **Effect of temperature on relative permeability.** Hagedorn, K.D. Stanford Univ., CA (USA). Petroleum Research Inst. Jun 1989. (SUPRI-TR–67). In *SUPRI Heavy Oil Research Program. Twelfth annual report, October 1, 1987 - September 30, 1988.* Order Number DE89000753/JAW. Available from NTIS, PC A09/MF A01.

A number of researchers have reported an increase in oil relative permeability, a decrease in residual oil saturation, and an increase in irreducible water saturation with increasing temperature. The systems used in these experiments differ considerably in the oils, brines, and rock materials used, and the magnitudes of the effects have varied widely. The purpose of this study was to conduct displacement experiments on consolidated sandstone and report the effects of temperature on end point values. The paper presents the results of the experimental runs and the modifications of the apparatus and analysis procedure that resulted from this study. Based on the results of this study, the following conclusions have been drawn: (1) The functional relationship used to match the N_p (dimensionless oil production in pore volume) data is appropriate for cores that yield rounded production curves after breakthrough. However, the production curves with little oil production after breakthrough are not matched well by this form. (2) Both oil and water relative permeabilities (k_{rw}) increased with increasing temperature to above 215°F. The effect on k_{rw} was completely reversible when the temperature was subsequently reduced. (3) Irreducible water saturation was not reached after 14 pore volumes of oil had been injected. The end point water saturation after 14 pore volumes of injection increased slightly with increasing temperature. (4) Practical residual oil saturation after 14 pore volumes of injected water increased slightly with increasing temperature.

41520 (DOE/BC/14126–8, pp. 25-41) **Comparison of relative permeability from centrifuging versus coreflooding.** Shimbo, D. Stanford Univ., CA (USA). Petroleum Research Inst. Jun 1989. (SUPRI-TR–67). In *SUPRI Heavy Oil Research Program. Twelfth annual report, October 1, 1987 - September 30, 1988.* Order Number DE89000753/JAW. Available from NTIS, PC A09/MF A01.

Laboratory measurement of relative permeability has traditionally taken place using unsteady-state coreflood tests. Procedures also exist for deriving relative permeabilities from centrifuge data, but the shapes of the curves are different than those from coreflooding. This research compared coreflood relative permeabilities versus centrifuge relative permeabilities by obtaining coreflood and centrifuge data from the same piece of Berea sandstone for gas/oil and oil/water systems. A one dimensional coreflood/centrifuge model, a least squares history matching algorithm, and the Corey relationships were used to reproduce the experimental data. Jones-Roszelle and Hagoort relative permeability curves were compared with the Corey curves that were obtained from simulation history matching. Comparison of the two sets of relative permeability curves from centrifuging versus coreflooding for the oil/water system displayed similar shapes and endpoints for the wetting phase, but showed different shapes and endpoints for the nonwetting phase.

41521 (DOE/BC/14126–8, pp. 43-69) **Ignition devices and methods for in-situ combustion.** Shallcross, D.C. Stanford Univ., CA (USA). Petroleum Research Inst. Jun 1989. (SUPRI-TR–67). In *SUPRI Heavy Oil Research Program. Twelfth annual report, October 1, 1987 - September 30, 1988.* Order Number DE89000753/JAW. Available from NTIS, PC A09/MF A01.

One of the most important tasks during a fireflood is to ensure the ignition of the oil-bearing stratum efficiently and safely. Many different devices have been developed and employed to achieve this aim. The target zone may ignite spontaneously upon injection of an oxygen-containing gas without the aid of special equipment. Alternatively, ignition may be hastened or enhanced by the use of gas-fired downhole burners, electric downhole heaters, or other, chemical means. Other methods involve increasing the reactivity of the formation contents by doping the stratum with compounds that ignite and burn more readily than the reservoir oil. This report surveys the range of ignition methods and devices that have been developed and applied in the field. Not only are successful ignition systems discussed, but also those designs that failed to ignite a formation. In discussing the various techniques, factors considered include reliability, specialized equipment and materials requirements, and safety. Another consideration is whether a system or device may be easily reused if ignition is not successful on the first attempt. The use of oxidizing gases other than air is also discussed. 88 references.

41522 (DOE/BC/14126–8, pp. 70-96) **Tube runs.** Baena, C. Stanford Univ., CA (USA). Petroleum Research Inst. Jun 1989. (SUPRI-TR–67). In *SUPRI Heavy Oil Research Program. Twelfth annual report, October 1, 1987 - September 30, 1988.* Order Number DE89000753/JAW. Available from NTIS, PC A09/MF A01.

The aim of this work was to use combustion tube studies to determine on a quantitative basis, how the nature and the amount of fuel formed could be changed by the presence of metallic additives. In this study, combustion tube runs were performed using the metallic additives iron, zinc and tin. Unconsolidated core samples were prepared by mixing predetermined amounts of an aqueous solution of the metal salt, Huntington Beach Crude Oil, Ottawa sand and clay in order to achieve the desired fluid saturations. The nature of the fuel formed and its impact on the combustion parameters were determined and compared with a control run - an experiment performed in the absence of any metallic additive. It was found that the presence of metallic additives increased the atomic hydrogen to carbon ratio of the fuel from 0.07 for the control run to 0.13 in the presence of iron, 0.61 with zinc present and 0.79 with tin. The H/C ratio of the fuel coupled with the extent to which the oxidation formed CO_2 in preference to CO affected the following combustion parameters: velocity of the burning front, heat of combustion of the deposited fuel, air requirements at 100% combustion efficiency, the air oil ratio and the oil recovery rates. As a result of the increased hydrogen content of fuel, the heat of combustion and the air requirements at 100% combustion efficiency increased as the H/C ratio increased. The presence of a metallic additive increased the burning front velocity and the oil recovery rate. However these were found to be affected by the oxygen utilization efficiency, the nature and the amount of fuel formed.

41523 (DOE/BC/14126–8, pp. 97) **Multi-phase, multi-component flow modeling in porous media with temperature variations.** Wingard, J. Stanford Univ., CA (USA). Petroleum Research Inst. Jun 1989. (SUPRI-TR–67). In *SUPRI Heavy Oil Research Program. Twelfth annual report, October 1, 1987 - September 30, 1988.* Order Number DE89000753/JAW. Available from NTIS, PC A09/MF A01.

A solution is presented for the differential equations describing multiphase, multicomponent flow in porous media by the method of characteristics. The model is extended to systems that have variation in temperature. The new model is then applied to a three component system of carbon dioxide, a heavy oil component, and water. The system contains vapor-liquid, liquid-liquid, and vapor-liquid-liquid regions over a wide range of temperatures and pressures. A composition grid for the system at 800° Rankine and 250 psia is shown and the technique is described for tracing the composition path through the phase diagram from injection conditions to initial conditions. Finally, a brief mention of the future plans for the completion of the project concludes the presentation.

41524 (DOE/BC/14126–8, pp. 99-109b) **Analysis of transient foam flow in porous medium with catscan.** Liu, D. Stanford Univ., CA (USA). Petroleum Research Inst. Jun 1989. (SUPRI-TR–67). In *SUPRI Heavy Oil Research Program. Twelfth annual report, October 1, 1987 - September 30, 1988.* Order Number DE89000753/JAW. Available from NTIS, PC A09/MF A01.

Many papers have been published investigating the effects of foam displacement of oil in the porous media. Most of the papers published so far have concentrated on steady state foam behavior. In fact, in the real world, steady state foam flow is not the usual state. In many of the experiments and field tests, foam flow must be transient in nature most of the time. Hence, it is important to study the transient behavior of foam flow. The purpose of this work has been to accumulate experimental data on transient foam flow and with the goal to finally build a semi-empirical mathematical model which will aid in the prediction and simulation of foam field tests. Equipment and calibration problems are described and a summary of results to date is given.

41525 (DOE/BC/14126–8, pp. 110-132) **Characterization of surfactants as steamflood additives.** Shallcross, D.C.; Castanier, L.M.; Brigham, W.E. Stanford Univ., CA (USA). Petroleum Research Inst. Jun 1989. (SUPRI-TR–67). In *SUPRI Heavy Oil Research Program. Twelfth annual report, October 1, 1987 - September 30, 1988.* Order Number DE89000753/JAW. Available from NTIS, PC A09/MF A01.

The efficiency of a steamflood can be increased by the use of surfactants that generate steam form within the oil reservoir. This paper reports the results of an experimental study into the foam-forming characteristics of seventeen different surfactants. Both commercially-available, and experimental surfactants were tested in a one-dimensional sandpack under controlled conditions of pressure and temperature similar to those for steam injection in California oil fields. The surfactant solutions were injected into the sandpack in discrete slugs of a finite duration allowing transient phenomena, such as the persistence of the foam, to be studied. Nitrogen was injected as a noncondensible gas. Four surfactants were found to cause foaming and additional pressure drop within the sandpack at low concentrations. Another aspect of the study was to link the foamability of surfactants with their chemical structure. Surfactants studied included, alpha olefin sulfonates, internal olefin sulfonates, linear alkyl-xylene sulfonates and linear toluene sulfonates. Under the conditions of the experiment, long chain alpha olefin sulfonates were found to generate the strongest foams. Internal olefin sulfonates, linear toluene sulfonates and linear alkyl-xylene sulfonates generated just as strong foams, but only at successively higher concentrations. In addition, by the novel use of heat flux sensors attached to the outside of the sandpack, heat loss from the one-dimensional model was studied. This allowed a better understanding of the heat transfer mechanisms operating within the tube. Such an understanding is important in correctly interpreting the experimental observations.

41526 (DOE/BC/14126–8, pp. 134-137) **Single well tracer studies.** Riley, M. Stanford Univ., CA (USA). Petroleum Research Inst. Jun 1989. (SUPRI-TR–67). In *SUPRI Heavy Oil Research Program. Twelfth annual report, October 1, 1987 - September 30, 1988.* Order Number DE89000753/JAW. Available from NTIS, PC A09/MF A01.

The purpose of the present research is to simplify already existing solutions to the radial Convection-Dispersion (C-D) equation. These solutions are quite complex, even in Laplace space. Since this topic was presented in last year's Annual Report, the introductory material is omitted for brevity. As indicated in the last annual report, the two methods used to find simplified solutions were changing of variables and perturbation. It was also stated that group theory might give some insights to the nature of the equation. The groups of the radial C-D equation have been calculated and show that the equation has very little symmetry. This shows why attempts at changing variables failed. Since perturbation also failed it was decided to abandon this research topic until other methods of solution can be found. This report is a review of the effort from January through June 1988. It will consist of two sections; Perturbation and Change of Variables. The first section will complete the tabulation of the Green's functions for the one dimensional C-D equation that were used in the perturbation scheme. The second section will give the groups for the one dimensional C-D and radial C-D equation and show why attempts at changing variables failed.

41527 (DOE/BC/14126–8, pp. 138) **Thermal recovery well test design and interpretation.** Ambastha, A. Stanford Univ., CA (USA). Petroleum Research Inst. Jun 1989. (SUPRI-TR–67). In *SUPRI Heavy Oil Research Program. Twelfth annual report, October 1, 1987 - September 30, 1988.* Order Number DE89000753/JAW. Available from NTIS, PC A09/MF A01.

This study considers transient pressure derivative behavior of a well in a two-region composite reservoir to establish the applicability and the limitations of different methods to estimate front radius or swept volume. A finite-radius well with wellbore storage and skin is assumed to produce (or inject) at a constant rate. Three outer boundary conditions are considered: infinite, closed, and constant-pressure. A study of drawdown and buildup responses has resulted in a set of correlating parameters for the pressure derivative responses, and new design and interpretation relations for well-tests in composite reservoirs. Guidelines have been presented for the applicability of different methods to estimate front radius. Dynamic phenomena, such as phase changes and multi-phase flow effects in a region near the front, can cause a sharp pressure drop at the front. Such a sharp pressure drop is modeled as a thin skin at the front in this study. An analytical solution for the transient pressure behavior of a well in a two-region composite reservoir with a skin at the front is obtained using the Laplace transformation. A thin skin at the front can explain a short duration pseudosteady state even for small mobility and storativity contrasts. The effects of a skin at the front are similar to the effects of storativity ratio. Thus, neglecting a thin skin at the front can cause large errors in parameter estimation using a type-curve matching method. Pressure derivative behavior of a well in a homogeneous, or a three-region composite reservoir is also discussed. Several well tests from composite reservoirs are analyzed to establish the applicability and the limitations of the deviation time method to estimate front radius.

41528 (DOE/BC/14126–8, pp. 139-143) **Flow through perforations.** Ahmed, G. Stanford Univ., CA (USA). Petroleum Research Inst. Jun 1989. (SUPRI-TR–67). In *SUPRI Heavy Oil Research Program. Twelfth annual report, October 1, 1987 - September 30, 1988.* Order Number DE89000753/JAW. Available from NTIS, PC A09/MF A01.

This approach follows developments in potential theory. A solution is first developed for a point source of known strength. The point source is then integrated to form a line source of uniform strength. The line source simulates the perforation with a uniform flux. Two alternative solutions are developed, the first involves Bessel's functions in the solution with the eigenvalues derived from an algebraic equation of Bessel's functions. For the second solution, eigenvalues are simply written down from a trigonometric identity and the solution contains expressions of Modified Bessel's functions.

41529 (DOE/BC/14126–8, pp. 145-173) **Comparison of Newton and Quasi-Newton methods for parallel reservoir simulators.** Barua, J.; Horne, R. Stanford Univ., CA (USA). Petroleum Research Inst. Jun 1989. (SUPRI-TR–67). In *SUPRI Heavy Oil Research Program. Twelfth annual report, October 1, 1987 - September 30, 1988.* Order Number DE89000753/JAW. Available from NTIS, PC A09/MF A01.

Parallel computers hold much promise for scientific computation. So a great deal of effort has been developed to finding ways to parallelize linear equation solvers. However in fully implicit reservoir simulators the original problem is the solution of non-linear equations. These nonlinear equations are usually solved using Newton's method. This report explores the use of Quasi-Newton methods to solve the nonlinear equations in parallel. The Quasi-Newton method turns out to have certain advantages and disadvantages. For example, using QN one can take the highly parallel iterative Jacobi matrix solution techniques, which are poorly convergent, and still get good serial performance. However the Quasi-Newton method does not do as well as Newton's method when using a preconditioned conjugate-gradient scheme - unless the cost of factorizing the preconditioner is high. Experiments on a parallel computer show that even with a highly parallel method, problem sizes need to be quite large to get good efficiency. The Quasi-Newton method can also be used to speed up serial programs if the cost of factorizing the preconditioner is high or if a simple iterative scheme is used.

41530 (DOE/BC/14126–8, pp. 174-185) **Steam drive semi-analytical model.** Gajdica, R. Stanford Univ., CA (USA). Petroleum Research Inst. Jun 1989. (SUPRI-TR–67). In *SUPRI Heavy Oil Research Program. Twelfth annual report, October 1, 1987 - September 30, 1988.* Order Number DE89000753/JAW. Available from NTIS, PC A09/MF A01.

The goal of this research is to develop a semi-analytical model that will predict the response of a reservoir to steam injection. The model should predict thermal reservoir simulator results without actually running the simulator. Effects of formation, water, and oil compressibility and thermal expansion should be accounted for. This contribution would allow quick, extensive analysis of thermal systems without the cost of simulation. Optimum reservoir operating conditions would be obtained and oil recovery maximized. The Computer Modelling Group general purpose thermal simulator ISCOM will be used to check results. A one-dimensional, three phase model that meets all of the above criteria has been completed. The model matches the thermal simulator pressure distributions, fluid saturation distributions, oil flow rates, water flow rates, breakthrough times, and cumulative productions quite well. Work is in progress on modifying the program into a two-dimensional cross-sectional system. Although gravity effects are accounted for in the one-dimensional model, there is no tendency toward phase segregation because there is only one grid block in the z direction. A two-dimensional model will have to account for the effects of gravity override of the steam and underrun of the water. Existing work dealing with the shapes of steam fronts will be used or modified to determine front shapes. This shape will be integrated into the one-dimensional model to form a two-dimensional model.

41531 (DOE/BC/14126–8, pp. 186-187) **Computerized axial tomography.** Castanier, L. Stanford Univ., CA (USA). Petroleum Research Inst. Jun 1989. (SUPRI-TR–67). In *SUPRI Heavy Oil Research Program. Twelfth annual report, October 1, 1987 - September 30, 1988.* Order Number DE89000753/JAW. Available from NTIS, PC A09/MF A01.

Computerized Axial Tomography (CAT-SCAN) is a non-destructive measurement technique using determination of X-ray adsorption coefficients to determine the density and/or the composition of a sample section. It has been used extensively in medical applications for the past 15 years. Recently, attempts have been made to apply this technique to petroleum related problems. A second generation CAT system was purchased and installed in the SUPRI laboratories. Calibration was performed on Ottawa sandpacks, Salem limestone and various sandstones. Measurement of liquid saturation in gas/water systems is possible within 0.5% saturation. An experiment aiming at the study of foam flow through porous media is now in progress.

41532 (DOE/BC/14204–T1) **Cyclic CO_2 injection for light oil recovery: Performance of a cost shared field test in Louisiana: Summary annual report.** Monger, T.G. Louisiana State Univ., Baton Rouge, LA (USA). Dept. of Petroleum Engineering. 15 Aug 1989. 7p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-89BC14204. Order Number DE89016463/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The ultimate objective of this research is to provide a base of knowledge on the CO_2 huff "n" puff process for the enhanced recovery of Louisiana crude oil. Project goals include laboratory corefloods to investigate several parameters important to the process, and numerical simulation to interpret coreflood results. Additional activities include construction and evaluation of a field test data base, and development of a radial core setup. Finally, Department of Energy sponsored field test(s) will be implemented and evaluated. The results of all laboratory and field evaluations will be made available to the industry through workshops, periodic reports and meetings.

41533 (DOE/ET/12002–2714) **Final report on the Rock Creek CO_2 injection project: Final report.** King, P.E. Jr. Pennzoil Co., Vienna, WV (USA). Jun 1989. 15p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-76ET12002. Order Number DE89001000/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The purpose of this report is to fulfill final contract requirements of the Rock Creek CO_2 injection project. The CO_2 project, located in Roane County, West Virginia, was operated from October, 1976 through October, 1985. This final report is intended to provide an executive summary for the project, the details of which are fully documented in previous contract reports and related technical papers. 9 figs., 6 tabs.

41534 (GU–OST85-00053) **A critical review of the light scattering technique in the determination of oil/water interfacial tension.** Guelph Univ., ON (Canada). 1985. 84p. (MICROLOG–87-00393). Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The behavior of surfactant-brine microemulsions in enhanced recovery involves a change from miscible to immiscible displacement as the surfactant concentration drops during the emulsion's movement through the porous rock. The way the immiscible displacement takes place depends on interfacial tension, and the anticipated oil recovery will depend on the details of the behavior in this multiphase region. Of greatest interest are the areas where microemulsion-oil and microemulsion-water interfacial tensions are low and equal. Since these tensions are extremely low, it is necessary to have extremely accurate measurement techniques. A review of classical techniques is presented, including force measurement methods, meniscii shape techniques, and miscellaneous classical techniques such as measurement of maximum bubble pressure, use of capillary tubes, and drainage methods. Special attention is paid to the use of light scattering. The feasibility of constructing a light scattering apparatus to perform surface tension measurements is evaluated. It is concluded that light scattering appears to be a superior technique for measuring low interfacial tensions, since it has a number of advantages, notably: applicability to a large variety of systems; accuracy; capability of measuring the bulk phase shear velocity; and a non-invasive nature. With the proper exponential arrangement, the same apparatus may be used to measure diffusion coefficients of micelles in the microemulsion phase. A proposed design for such an apparatus is presented. 97 refs., 12 figs.

41535 (INIS-mf–11495, pp. 224-226) **Radioisotope tracers in enhanced oil recovery.** Hanna, G.L. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)); Jamal, F. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The use of secondary recovery practices can increase significantly the recovery of oil from its reservoir. The practice adopted must be suited to the type of oil and the reservoir characteristics. The Tirrawarra oil and gas field in South Australia is a low permeability reservoir which is being developed using the miscible gas flood technique. Radiotracers are being used to help evaluate the process and optimise oil production. The early results from Tirrawarra are described.

41536 (MEM/P–1986) **1986 Annual production statistics report [Manitoba].** Manitoba Dept. of Energy and Mines, Winnipeg, MB (Canada). Petroleum Div. 1986. 145p. (MICROLOG–87-03689). Available from Manitoba Dept. of Energy and Mines, Legislative Bldg., Rm. 301, Winnipeg, Man., CAN R3C 0V8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report presents numerical data on Manitoba crude oil production. Data are printed in a field/pool code format, which groups wells according to the field in which they are located and by the pool from which they produce or to which they dispose or inject. Within each pool, unitized operations are shown, followed by non-unit wells within the pool, grouped by operator. Oil production figures and salt water production figures are shown in cubic meters, on a cumulative and monthly basis. Production from confidential wells is shown as a total number only. 3 figs.

41537 (NEI-NO–86 D3c 6) **Composite materials. An alternative to steel for offshore applications.** Waestberg, S. (Veritec Technology and Services A/S, Oslo (Norway)). Norsk Petroleumsforening, Oslo (Norway). 1988. (CONF-8808151–: Offshore northern seas conference and exhibition, Stavanger (Norway), 23-26 Aug 1988). In *Deepwater technology.* Order Number DE89776212/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Fibre reinforced plastics and sandwich elements present interesting alternatives to steel materials for a number of applications in the offshore industry. In view of their many advantages, both economical and technical, the use of these materials is sure to increase significantly in the near future.

41538 (NEI-NO–86 D6 19) **TOGI project - extending subsea development, control and monitoring systems.** Weibye, B.S. (Norsk Hydro A/S, Oslo (Norway)). Norsk Petroleumsforening, Oslo (Norway). 1988. (CONF-8808151–: Offshore northern seas conference and exhibition, Stavanger (Norway), 23-26 Aug 1988). In *Deepwater technology.* Order Number DE89776212/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

In mid-1986 the Norwegian authorities approved the go-ahead for the Troll-Oseberg Gas Injection Project (TOGI) with Norsk Hydro as the operator. The objective of the project is to deliver a daily average quantity of over 7 million Sm^3Troll gas to the Oseberg Field Centre for 12 years from 1991. This gas is to be injected into the Oseberg Alpha reservoir structure to achieve up to 10% increase in ultimate oil recovery over that which would be obtainable from a pressure maintenance scheme based on water injection. The TOGI Project Team recognised from the outset the variety and magnitude of the challenges inherent in the execution of the project. The two most dominant development parameters giving rise to all the main technical challenges have been the water depth in excess of 300m and the separation distance of nearly 50 km from the control, monitoring and processing platform. It was also clear however, that once Norsk Hydro had successfully conquered these challenges and could demonstrate a technically sound and cost-effective remote deepwater gas production system, operating reliably in the Troll Field, then this would represent a major milestone in the industries ability to respond convincingly to many similar and even greater oil and gas development challenges ahead on the Norwegian Shelf. Norsk Hydro has been pleased with the response of the industry so far. Great efforts have been made by both Norsk Hydro and suppliers over recent years to qualify all the necessary components either through operational experiences in the field or through exhaustive simulated test programmes. 5 figs.

41539 A phase and electrical conductivity study of model oilfield dispersions. Smith, D.H. (U.S. DOE/METC (US)); Lim, K.H. vp. of Proceedings of the 1989 SPE international symposium on oilfield chemistry. Society of Petroleum Engineers, Richardson, TX (1989). (CONF-890235–: Society of Petroleum Engineers international symposium on oilfield chemistry, 8-10 Feb 1989).

Technical Paper SPE 18496.

Using the surfactant/oil/water system n-$C_4H_9OC_2H_4OH$/n-$C_{10}H_{22}$/brine (0.10 M NaCl) and electrical conductivity measurements, the authors have determined the emulsion morphologies and the phase volume fractions at which inversion occurred at a temperature below the lower critical endpoint temperature and at a temperature above the upper critical endpoint temperature. In both cases, inversion occurred at 45 ± 5 volume percent internal phase when that phase was the water-rich phase and at 60 ± 5 volume percent internal phase when that phase was the oil-rich phase. These results contradict the correlation between phase behavior and emulsion morphology that has been almost universally reported in the oil-recovery literature, but are in much better accord with models for emulsion inversion that are based on packing arguments.

41540 A new method for studying phase behavior of enhanced oil recovery surfactant systems. Smith, D.H. (U.S. DOE/METC (US)); Covatch, G.L. vp. of Proceedings of the 1989 SPE international symposium on oilfield chemistry. Society of Petroleum Engineers, Richardson, TX (1989). (CONF-890235--: Society of Petroleum Engineers international symposium on oilfield chemistry, 8-10 Feb 1989).

Technical Paper SPE 18498.

The use of isoperibol calorimetry to obtain phase boundaries and compositions for two-phase amphiphile/water systems and three phase surfactant/oil/water systems is demonstrated. Because the phase data are obtained without waiting for emulsions to break, the calorimetric technique is much faster than conventional methods. Furthermore, the technique yields heats of mixing (excess enthalpies), which are needed for the development of equations-of-state and the prediction of phase behavior. Because the samples studied need not transmit light, the calorimetric technique eventually may prove very useful for the study of surfactant/CO_2/oil/water miscible-flood mobility control systems and systems that contain black oil.

41541 Thermal recovery well test design and interpretation. Ambastha, A.K. (0184000); Ramey, H.J. Jr. *SPE (Society of Petroleum Engineers) Formation Evaluation (USA),* 4(2): 173-180 (Jun 1989).

Because a reservoir undergoing a thermal recovery process is typically idealized as a composite reservoir, this study develops new design and interpretation equations by investigating pressure-derivative behavior of a well in a two-zone, radial, infinite or finite composite reservoir. Accurate design equations help establish the test duration required to observe a particular feature in well test data and thus the applicability of an interpretation method to determine front radius, or swept volume. This study shows that the dimensionless time to the end of the first semilog line (deviation time) based on front radius is a constant. The deviation-time method may be used if wellbore storage does not mask the first semilog line. Design equations for the time of the beginning of the second semilog line and the time to observe outer-boundary effects show that the intersection-time method is not suitable for thermal recovery well test analysis. Correlations developed for the end of pseudosteady-state behavior of the swept region should help select the correct Cartesian line to calculate swept volume. This paper also presents derivative type curves applicable for all front radii, with mobility and storativity ratios as parameters for infinite large composite reservoirs. For closed and constant-pressure outer boundaries, the ratio of outer boundary to front radius is the third parameter.

41542 Further investigation of high-temperature alkaline floods. Mehdizadeh, A. (9501365); Handy, L.L. *SPE (Society of Petroleum Engineers) Reservoir Engineering (USA),* 4(2): 171-177 (May 1989).

Effectiveness of alkalies, such as NaOH, Na_2SiO_3, and Na_2CO_3, to recover residual oil during hot waterfloods (356°F [180°C]) was investigated and compared. These alkalies, with or without surfactants, may be added to steam to enhance oil recovery from that portion of the reservoir subjected to a hot waterflood during steam injection. Tertiary flood rate and concentration of the injected alkalies were changed and their corresponding effects on recovery efficiency, WOR, recovery mechanism, and alkali consumption were studied. Some lower-temperature floods were also performed with caustic. Dynamic interfacial tensions (IFT's) between the acidic crude oil and the alkaline solutions at different pH's were measured at elevated temperatures up to 356°F [180°C] with a drop-weight technique. For some alkalies (e.g., NaOH), the effects of salt and surfactant addition were also investigated. The results show that dynamic IFT's between the acidic crude oil and the alkaline solutions increase with increase in temperature. At high temperatures, IFT values at low pH approach values obtained for distilled water. This is more pronounced for caustic than for sodium metasilicate and sodium carbonate. The same IFT values obtained for caustic at elevated temperatures can be obtained with sodium carbonate and sodium metasilicate at a lower solution pH. Although IFT and alkali consumption increase with an increase in temperature, recovery efficiencies obtained at high temperatures were comparable with those obtained at lower temperatures.

41543 Influence of natural fractures on hydraulic fracture propagation. Teufel, L.W. (Sandia National Labs., Albuquerque, NM (USA)); Warpinski, N.R. *AAPG (American Association of Petroleum Geologists) Bulletin (USA),* 72(2): 253 (Feb 1988). (CONF-880301--: Annual meeting of the American Association of Petroleum Geologists, 20-23 Mar 1988).

Hydraulic fracturing has become a valuable technique for the stimulation of oil, gas, and geothermal reservoirs in a variety of reservoir rocks. In many applications, only short fractures are needed for economic production. In low-permeability reservoirs, however, long penetrating fractures are generally needed, and in this case, natural fractures can be the cause of many adverse effects during a fracture treatment. Natural fractures can influence the overall geometry and effectiveness of the hydraulic fracture by: (1) arresting the vertical or lateral growth, (2) reducing total fracture length via fluid leakoff, (3) limiting proppant transport and placement, and (4) enhancing the creation of multiple or secondary fractures rather than a single planar hydraulic fracture. The result may range from negligible to catastrophic depending on the values of the ancillary treatment and reservoir parameters, such as the treating pressure, in-situ stresses, pore pressure, orientations of the natural fractures relative to principal in-situ stresses, spacing and distribution of the natural fractures, permeability, etc. Field observations from mineback experiments at DOE's Nevada Test Site and the multiwell experiment in Colorado, laboratory tests, and analyses of these data are integrated to describe the complex fracture behavior found and to provide guidelines for predicting when this complex fracturing will occur.

0204 Processing

Refer also to citation(s) 41430, 42715

41544 (DOE/EIA–M037/1) **Refinery Yield Model Spreadsheet System (RYMSS) user's manual.** USDOE Energy Information Administration, Washington, DC (USA). Apr 1989. 22p. Sponsored by U.S. DOE Management & Administration. Order Number DE89016126/JAW. Available from NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.

The Refinery Yield Model Spreadsheet System (RYMSS) is a LOTUS 1-2-3 spreadsheet model that simulates refinery operations, including the processing of 28 reference crude oils and other raw material inputs into over 20 finished products using 17 refinery processes. RYMSS estimates refinery yields and net margins for a single refinery or a group of refineries within the United States. RYMSS estimates can be used to determine the potential impact on refinery operations of changes in any one or a combination of several variables, including product demand, prices and specifications, raw material/crude oil costs, and process unit capacities and utilizations.

41545 (MC/SC–8609) **Instrument loop diagrams pilot plant electronic instrumentation system. Phase 1, task 1 and 2.** Monenco Consultants Ltd., St. Catherines, ON (Canada). 1986. 364p. (MICROLOG–87-01223). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

This document consists entirely of drawings and specifications related to the instrument loops of the electronic instrumentation system at a heavy oil coprocessing pilot plant at the Bell's Corners Complex of Energy, Mines and Resources Canada. The design of associated instrument panels includes panel layout and panel wiring diagrams in sufficient detail to allow mechanical and electrical construction of each panel. Cable groupings and junction box design are also provided. The instrument loops are relevant to the slurry feed system, feed preheat and dump system, reactor and sampling system, heavy oil system, light oil system, water scrubber system, oil scrubber system, recycle gas system, oil and Varsol purge system, off gas system, hydrogen supply system, and hydrogen purge system. 282 figs.

41546 The future of extra heavy oil, natural bitumen, and shale oil. Stosur, G.J. (US Dept. of Energy, Washington, DC (US)); Frye, K.N. vp. of Proceedings of the twelfth world petroleum congress. Water Pollution Control Federation, Washington, DC (1987). (CONF-870414–: 12. world petroleum congress, 26 Apr - 1 may 1987).

Conventional petroleum prices are expected to begin rising again in the 1990s as a result of resource depletion and continued economic growth, particularly in less developed countries. A fossil liquids supply shortfall may result. Production experience, at least on a pilot scale, exists for extra heavy oil, natural bitumen, and shale oil. Technological advancement through R and D, leading to reduced costs and reduced environmental impacts, is necessary for further development of these resources. Extra heavy oil could be a relatively low cost development option if infrastructure constraints can be overcome. Shale oil suffers less from lack of infrastructure but requires significant technological advances, though opportunities for technical breakthroughs may be greatest with this resource, and the resource base is large. An analysis of hypothetical scenarios shows that potential production from extra heavy oil, bitumen, and shale oil could be approximately 20 million barrels per day by the year 2030, or approximately 35% of total petroleum production. Collaborative R and D programs can be effective in overcoming the technical constraints in order to achieve these levels of commercial production.

0205 Products and By-products

Refer also to citation(s) 41416, 41606, 41884, 42414, 43437

41547 (AD-A–206053/1/XAB) **Field evaluation of all-season tactical engine oil OE/HDO-15/40 at Ft. Knox, Kentucky and Ft. Bliss, Texas. Interim report, July 1984-December 1985.** Butler, W.E.; Alvarez, R.A.; Buckingham, J.P.; Owens, E.C.; Bowen, T.C. Southwest Research Inst., San Antonio, TX (USA). Belvoir Fuels and Lubricants Research Facility. Jul 1986. 208p. (BFLRF–217). Available from NTIS, PC A10/MF A01.

Requirements for a multiviscosity grade 15W-40 engine oil were developed and the lubricant introduced for military consumption. The program efforts cover a demonstration and field-validation program of the newly introduced grade 15W-40 lubricant. The test involved a wide variety of combat, tactical, and support equipment operated by the 2D Squadron, 6th Cavalry at Fort Knox, KY, and the 3D Armored Cavalry Regiment at Fort Bliss, TX. During the test, vehicles accumulated in excess of 1,840,000 miles of operation under ambient conditions ranging from monthly low temperatures of -8 C (18 F) at Fort Knox to monthly high temperatures of 35 C (95 F) at Fort Bliss. Two-grade 15W-40, MIL-L-2104D qualified lubricants were employed in the test, one product at each of the test locations. The test lubricants were used in all equipment components, engines, transmissions, hydraulic systems, etc., that required MIL-L-2104 engine oil. Equipment within the test fleets were monitored in regard to wear performance, frequency of component replacement, and operational characteristics. Overall, the grade 15W-40 products demonstrated satisfactory and equivalent performance to single-graded oils. The oil was well received by both operators and maintenance personnel who noted that the grade 15W-40 products significantly reduced logistics burden by having only one grade product to requisition, store, and transport to the field.

41548 (AD-A–206792/4/XAB) **Modification of the Gerin Falling Ball Viscosity Comparator Model V3 for use at the standard test temperature of 100°C. Technical memo.** Haggett, R.D.; Matthews, J.R.; Veinot, D.E. Defence Research Establishment Atlantic, Dartmouth, NS (Canada). Mar 1989. 32p. (DREA-TM–89/207). Available from NTIS, PC A03/MF A01.

This report describes a modification to the Gerin Falling Ball Viscosity Comparator Model V3 for use at the standard test temperature of 100 C, which has been developed and tested at DREA Dockyard Laboratory. The Modified Falling Ball Viscosity Comparator when used at 100 C can accurately determine a percent change in the viscosity of a used MIL-L-9000G diesel lubricating oil compared to new oil of the same specification, regardless of the batch and/or manufacturer. This viscosity change can be determined onboard ship and used as a go/no-go indicator of the suitability for further service of a diesel lubricating oil. When used with fuel-diluted solutions of known concentration, the Modified Falling Ball Viscosity Comparator can be used to quantitatively determine the percentage fuel dilution in used diesel lubricating oil. Test and evaluation, Canada, Lubricating oils.

41549 (EMR–00329) **Utilization of C_4's and C_5's of ethylene plants and FCC units through transformation to octane boosters for unleaded gasoline.** Oballa, M.; Kzywicki, A. Department of Energy, Mines and Resources, Ottawa, ON (Canada). 1988. 193p. (MICROLOG–89-02179). Available from Canada Centre for Mineral and Energy Technology, Technical Information Division, 562 Booth St., Room 20C, Ottawa, ON, CAN K1A 0G1; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The state of the art technologies for processing C_4's and C_5's to octane enhancers for gasoline are renewed, along with the nature and characteristics of the catalysts used in these processes. The possible products of those technologies, methods for producing the desired product slate; and the chemical analysis of the feedstocks and products are discussed. The report describes the properties and blending of oxygenates, including methanol, ethanol, and methyl tertiary butyl ether (MTBE); the thermodynamics, reaction kinetics, and catalysts applicable to the syntheses of these octane enhancers, the technology and economics of the various industrial processes, the methods of analytical chemistry applicable to oxygenates in gasolines, and the performance of oxygenated gasolines in automobiles, including their effects on pollution. A list of MTBE plants worldwide is given. There are three routes for the upgrading of C_4's and C_5's to saleable octane enhancers: upgrading to oxygenates for octane number enhancement; upgrading to petrochemical feedstocks; and integrated processing yielding both oxygenates and petrochemical feedstocks. Integration makes it possible to optimize the numerous process recycle streams between the units; it also paves the way to the maximum utilization of off-gas streams, so that product yield and energy efficiency are enhanced. The market for oxygenates appears promising. Recommendations are made for research priorities in the future. 205 refs., 25 figs., 24 tabs.

41550 (PB–89-178065/XAB) **Special AC-20 asphalt. Final report, June 1978-February 1987.** Mellott, D.B. Pennsylvania Dept. of Transportation, Harrisburg, PA (USA). Bureau of Bridge and Roadway Technology. May 1987. 21p. (REPT–78-4). Available from NTIS, PC A03/MF A01.

The purpose of the project was to evaluate the service performance of ID-2 wearing course material using AC-20 asphalt that is currently being specified and the older specification AC-20 that had a lower-penetration specification. The aging properties of the two different asphalts, with different penetration characteristics in the asphalt binders and asphaltic mixes and their relation to pavement durability were studied in detail.

41551 (PB–89-178073/XAB) **Evaluation of polymer-modified asphalts for seal-coat construction. Report for July 1987-December 1988.** Mellott, D.B. Pennsylvania Dept. of Transportation, Harrisburg, PA (USA). Bureau of Bridge and Roadway Technology. Dec 1988. 20p. (REPT–87-50). Available from NTIS, PC A03/MF A01.

The purpose of the research project is to evaluate the effectiveness of various polymer-modified asphalts in bituminous seal-coat

and surface treatments. It is hoped that the additives will promote better adhesion of the aggregate in seal-coat and surface-treatment construction.

41552 (PB–89-178883/XAB) **Study to determine the fate of benzene precursors in gasoline. Final report.** Marshall, W.F. National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA). Dec 1988. 91p. Available from NTIS, PC A05/MF A01.

Exhaust emissions from five late-model vehicles were measured to determine the effect of aromatic fuel components on benzene emissions. The purpose of the work was to determine if there are any fuel components that are major sources of benzene emissions. Reducing the content of such components in gasoline could then be a means of reducing benzene emissions. Analyses of engine-out (before catalyst) and tailpipe-out (after catalyst) exhaust emissions were made to determine catalyst efficiency for reducing benzene emissions. Benzene (in fuel) effect on benzene exhaust emissions was much greater than that of the other aromatic species. The benzene reduction efficiency of the exhaust emissions control systems was about the same as total hydrocarbon reduction efficiency. Benzene emissions were reduced by 70 to 95% by the exhaust emission control systems. Predictive equations were developed using the results of the study. These equations enable estimation of the changes in the benzene emissions as a function of changes in gasoline composition.

41553 (PB–89-185581/XAB) **Combustion of oil on water. November 1987.** Evans, D.; Baum, H.; McCaffrey, B.; Mulholland, G.; Harkleroad, M. National Bureau of Standards, Washington, DC (USA). Center for Fire Research. Jun 1986. 56p. (NBSIR–86/3420). Available from NTIS, PC A04/MF A01.

See also PB–89-149173.

This report contains the results of measurements performed on both 0.4-m and 0.6-m diameter pool fires produced by burning a layer of Prudhoe Bay crude oil supported by a thermally deep layer of water. Both steady and vigorous burning caused by boiling of the water sublayer were observed. The measured energy release rate for steady burning was about 640 kW per sq meter. The emission rate, the size distribution, and specific extinction coefficient were measured for the smoke aerosol produced by the fires. Data were also obtained on the structure of the smoke aerosol by electron microscopy and on emission of CO and CO_2. Analysis of the crude oil burn residue indicated selected depletion of the short-chain alkanes and cycloalkanes when compared to the fresh oil. Mono-ring aromatics including benzene, toluene, and xylenes present in the fresh crude were absent in the burn residue. Calculations of the induced air flow into a simulated distribution of 20 fires over a 100 m x 100 m area showed that the maximum inflow velocity near the largest size fire (2.5 m diameter, 3.2 MW) was 1.1 m/s.

41554 Hydrolysis in supercritical water. Huppert, G.L. (2105000); Wu, B.C.; Townsend, S.H.; Klein, M.T.; Paspek, S.C. *Industrial and Engineering Chemistry Research (USA)*, 28(2): 161-164 (Feb 1989).

Reaction of guaiacol (o-methoxyphenol) in supercritical water and with added salts showed its hydrolysis to catechol (o-hydroxyphenol) and methanol to be through a polar transition state. Correlation of the reaction kinetics following a modified Herbrandson analysis provided a quantitative summary of the greater polarity of the hydrolysis transition state relative to the hydrolysis reactants. Salt addition further shifted the transition-state equilibrium toward the transition-state species.

0207 Marketing and Economics

Refer also to citation(s) 42330

41555 (AEC–89) **Alberta Energy Company Ltd. 1987 annual report. Turning resources into opportunities.** Alberta Energy Co. Ltd., Edmonton, AB (Canada). [1989]. 40p. (CE–02680). Available from Alberta Energy Company Ltd., 1200, 10707-100 Avenue, Edmonton, AB, CAN T5J 3M1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Alberta Energy Company (AEC) is active in synthetic and conventional oil production, gas production, forest products, pipelines, and petrochemicals. It also participates in the electric utility, coal, oil and gas drilling, and vehicle leasing businesses. Petroleum and natural gas interests are held in western Canada and the Beaufort Sea, and oil sands interests in Alberta. The Corporation also owns substantial interest in Chieftain Development, Pan-Alberta Gas, and Pan-Alberta Resources; a 10% interest in the Syncrude oil sand mining operation; majority interest in AEC Power, which supplies power and steam to Syncrude. Minority interests are held in an anhydrous ammonia plant, an Alberta coal mine, and the IPSCO steel company. Pipeline-related activities of the Corporation include the Alberta Oil Sands Pipeline, the Cold Lake Heavy Oil Pipeline, the Alberta Ethane Gathering System, and the Wabasca River Pipeline. AEC will participate in the proposed Vancouver Island Pipeline and Iroquois Gas Transmission System projects. Forest product activities include lumber and fiberboard production. AEC also plans to build a chemithermomechanical pulp mill in Alberta. This report details the year's activities of the company and includes financial statements.

41556 (DOE/EIA–0109(89/05)) **Petroleum supply monthly, May 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 27 Jul 1989. 131p. Sponsored by U.S. DOE Management & Administration. Order Number DE89016375/JAW. Available from NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.

The Petroleum Supply Monthly (PSM) is one of a family of three publications produced by the Petroleum Supply Division within the Energy Information Administration (EIA) reflecting different levels of data timeliness and completeness. The order two publications are the Weekly Petroleum Status Report (WPSR) and the Petroleum Supply Annual (PSA). Data presented in the PSM describe the supply and disposition of petroleum products in the United States and major US geographic regions. The data describe production, imports and exports, inter-Petroleum Administration for Defense (PAD) District movements, and inventories by the primary suppliers of petroleum products in the United States (50 States and the District of Columbia). The reporting universe includes those petroleum sectors in "Primary Supply." Included are: petroleum refiners, motor gasoline blenders, operators of natural gas processing plants and fractionators, inter-PAD transporters, importers, and major inventory holders of petroleum products and crude oil. When aggregated, the data reported by these sectors approximately represent the consumption of petroleum products in the United States.

41557 (MOG–1986) **Manitoba oil and gas corporation annual report, 1986.** Manitoba Oil and Gas Corp., Winnipeg, MB (Canada). 1986. V (MICROLOG–87-03688). Available from Manitoba Oil and Gas Corporation, 870-330 Graham Ave., Winnipeg, MB, CAN R3C 4A5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Manitoba Oil and Gas is a Crown corporation established in 1983 to participate in the development of the province's oil and gas resources through direct participation in oil and gas exploration and development, and to achieve corporate profitability. This report presents financial and operating highlights of the year, with some comparisons made to the previous 2 years. Details are presented concerning activities of the corporation in exploration and development, and production and reserves. Some highlights of 1986 include participation in 28 wells, over 80% of which were successful; increasing the proven reserve base to 1.08 million bbl compared with 375,000 bbl in 1985; and increasing average daily production to 110 bbl/d at year end from 55 bbl/d in 1985. A financial statement is included. 5 figs., 2 tabs.

41558 (NEI-NO–85 C1 17) **Cost consideration factors.** Regnault, A. (Elf Aquitaine Norge A/S, Oslo (Norway)). Norsk Petroleumsforening, Oslo (Norway). 1988. (CONF-8808151–: Offshore northern seas conference and exhibition, Stavanger (Norway), 23-26 Aug 1988). In *Cost effectiveness.* Order Number DE89776211/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Oil compagnies are increasingly obliged to take account of the cost aspects at all stages in the process from exploration, appraisal and development to production. The global objective is safe and cost-effective operations, to provide viable economic returns. The progress in various techniques and the new technologies as well as

the somewhat different type of fields the Oil Companies have to cope with in already developed oil provinces, have increased the number of parameters and the range of solutions on which they can draw to achieve cost reduction and cost-effectiveness. The selection of the development scheme and production options is of primary importance in achieving such an objective. A progressive or step-by-step approach to development can bring about positive results and deserves to be considered by the Oil Companies. Both an innovative approach through the use of new technologies and progressive development require also to be looked upon with an open mind and a positive attitude by the relevant Governing Authorities. During the complex process of the project implementation, the motivation of the Contractor Industry is an important factor. New contractual policy can provide such motivation. 2 figs.

41559 (NEI-NO–85 C3 14) **Integrated approach to cost consciousness.** Morgan, R.E. (BP Exploration, London (UK)). Norsk Petroleumsforening, Oslo (Norway). 1988. (CONF-8808151–: Offshore northern seas conference and exhibition, Stavanger (Norway), 23-26 Aug 1988). In *Cost effectiveness*. Order Number DE89776211/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Cost consciousness was given a very necessary boost by the collapse of oil prices in 1986 and downward movements in prices have served to re-inforce the need for vigilance: oil companies were becoming complacent. The climate necessary for cost consciousness to flourish as part of the oil company culture is established by higher management attitude and can be reinforced by organizational structure. British Petroleum's current production/exploration organisational structure is reported on in the first section of this paper and this is followed by a discussion of pertinent cost-oriented observations to emerge from this grouping related both to the component phases of the exploitation of a field, and to the cost of engineering/managing same.

0208 Waste Management

Refer also to citation(s) 43040

41560 (DOME–100) **Beaufort Sea dispersant trial.** Swiss, J.J.; Vanderkooy, N. Dome Petroleum Ltd., Calgary, AB (Canada). 1988. 118p. (MICROLOG–89-02440). Available from Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In August 1986, an offshore dispersant trial was conducted in the Beaufort Sea. The purpose of this trial was to determine the effectiveness of aerially applied dispersants under arctic conditions, to evaluate the efficacy of multi-hit dispersant application, and to define the logistic and cost considerations for conducting a full-scale dispersant operation in the Beaufort Sea. All of the objectives outlined in the trial protocol were achieved as planned. In general, the results indicated that it is logistically possible to conduct an aerial dispersant operation in the Arctic and that there is some indication (mostly visual and photographic) that dispersants produce the desired effect. In spite of this, there is still no clear evidence that dispersants are as effective as they need to be for environmental protection purposes. The trial showed that some mechanism that creates a phenomenon known as 'emulsion balls' interferes with the dispersion process and results in an overall reduction in dispersant effectiveness. These 'balls' formed on the surface of the water in each of the sprayed slicks and tended to confuse the interpretation of the infrared imagery, which was the prime method used in determining dispersant effectiveness. Until the uncertainties created by the presence of these balls can be resolved, the use of remote sensing as a technique for determining dispersant effectiveness should be supported with an adequate ground truthing program. 21 refs., 35 figs., 6 tabs.

41561 (PACE–86-2) **Waste management guidelines for petroleum refineries and upgraders.** Budzik, P.T. Petroleum Association of Conservation of the Canadian Environment, Ottawa, ON (Canada). 1986. 280p. (MICROLOG–89-02851). Available from Petroleum Association for Conservation of the Canadian Environment (PACE), 1202-275 Slater St., Ottawa, ON, CAN K1P 5H9; $25.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This manual was commissioned by the petroleum industry of Canada to provide general direction to petroleum plants as to what constitutes good operating practices in the handling, storage, transport, treatment, and disposal of their waste materials. It provides a mechanism to identify hazardous wastes and to determine appropriate disposal and treatment procedures. The first part compendium of waste data sheets, each containing relevant information specific to a given waste, plus guidelines indicating the preferred options for the treatment and disposal of that waste. The second part provides background information on the nature of the waste management problem, current industry practices, the transportation of wastes, legislation, and treatment and disposal technology. Seven appendices comprise a glossary of terms, a summary of the applicable legislation and regulations, a compendium of licensed and approved hazardous waste treatment and disposal facilities, testing and monitoring protocols, and a bibliography. This report is based on a thorough survey of the petroleum industry in Canada. 53 refs., 11 figs., 12 tabs.

41562 (PB–89-182919/XAB) **Native-species establishment on an oil-drill pad site in the Uintah Mountains, Utah: effects of introduced grass density and fertilizer. Forest Service research paper.** Chambers, J.C. Forest Service, Ogden, UT (USA). Intermountain Research Station. Mar 1989. 13p. (FSRP/INT–402). Available from NTIS, PC A03/MF A01.

This study examined the effects of introduced grass seeding density and fertilizer on native-species establishment on an oil drill-pad site in the Uintah Mountains, UT. Differences in first-year seeding density and 3-year standing crop biomass among treatments were evaluated for seeded introduced grasses and native species and for unseeded colonizers. Aerial cover was measured all 3 years and the effects of fertilization on soil NO_3(2-), N, available P, and exchangeable K were examined 2 years after application. Recommendations for reclamation of similar sites are given.

0209 Environmental Aspects

Refer also to citation(s) 41585, 41586, 42601, 42602, 43431, 43467, 43471, 43472, 43473, 43474, 43475, 43476, 43486, 43632

41563 (AC/O–8704) **High pressure water jet barrier. Design optimization.** Arctec Canada Ltd., Ottawa, ON (Canada). 1987. 133p. (MICROLOG–87-05113). Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The problem of optimizing the operation of a high pressure water jet barrier for use in oil spill containment is examined in this report. An experimental investigation was carried out in which the air flow velocities were measured and their variation with relevant parameters was identified. The experimental set-up allowed simultaneous measurement of air flow velocity for a series of water jets. An attempt was also made to measure water current velocity. A modification to the apparatus allowed limited testing of multiple nozzle configurations. A laser doppler anemometer system was successfully utilized to extract the air flow velocity of the two phase water jet. As a result of the experimental study, several trends were identified which affected the performance of a nozzle. Increasing pressure from 1000 psi to 3000 psi translated into higher current velocity, but only marginal variations in air flow flux or broadness. As the depression angle (below the horizontal) was increased to about 15 degrees, the airflow was reduced to zero. No significant reduction in airflow velocity was observed as the water jet nozzle was progressively raised to its maximum height of 30.5 cm. A methodology of establishing optimum spacing of multiple water jets was proposed which utilized the collected broadness data. An estimation of minimum power requirements is provided for each of the nozzles tested. The trends observed in the airflow analysis and power caluclation sug gest that selection of a small aperture, large

flare angle water jet nozzle will result in optimum performance of the barrier. 2 refs 56 figs 6 tabs

41564 (EGG–10617-2020) **Endangered species program, Naval Petroleum Reserves in California: Annual report FY88.** EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations. Jan 1989. 61p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC08-88NV10617. Order Number DE89015315/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Construction and development activities conducted at Naval Petroleum Reserve No. 1 (NPR-1) potentially threatened the continued existence of four federally-listed endangered species; the San Joaquin kit fox, (Vulpes macrotis mutica), blunt-nosed leopard lizard (Gambelia silus), giant kangaroo rat (Dipodomys engines), and Tipton kangaroo rat (Dipodomys nitratoides nitratoides). All four are protected under the Endangered Species Act of 1973. We are also obliged to determine whether actions taken by lessees on Naval Petroleum Reserve No. 2 (NPR-2) will have any detrimental effects on endangered species or their habitats. NPR-1 and NPR-2 are located approximately 26 miles west-southwest and southwest, respectively, of Bakersfield, Kern County, California. NPR-1 consists of 47,245 acres and is located just north of NPR-2 and abuts its northwestern border. NPR-2 consists of 30,080 acres of which 10,400 acres are administered by DOE. The remainder of NPR-2 is privately owned and the city of Taft occupies 1,280 acres in the southern corner. The major objective of the Endangered Species Program on NPR-1 and NPR-2 is to provide DOE with the scientific expertise and continuity of programs necessary for continued compliance with the Endangered Species Act. The specific objective of this report is to summarize progress and results of the Endangered Species Program made during Fiscal Year 1988 (FY88).

41565 (EPS–13) **Beaufort Sea 1985 shoreline drift waste survey.** Shearer, R.G.; Bourque, M. Environment Canada, Ottawa, ON (Canada). Environmental Protection Service. 1987. 41p. (MICROLOG–87-04945). Available from Environmental Protection Service, Environment Canada, 351 St. Joseph Blvd., Terrasses de la Chaudie@'re, Ottawa, ON, CAN K1A 0E7; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Pre-drilling and post-drilling season surveys were conducted in July and September, 1985, respectively, along the Beaufort Sea shoreline from Tent Point, Yukon, to Nuvorak Point, Northwest Territories to assess whether a waste cleanup program was warranted in 1987. The results of the two 1985 surveys indicated that over 90% of the drift wastes sighted along the Beaufort Sea shorelines had originated with the oil and gas industry. The total number of waste sightings increased by 68% in the post-drilling survey compared to the sightings in the pre-drilling survey. This higher sighting frequency was attributed to industrial activity between survey dates. The frequency of waste sightings recorded during the two 1985 surveys was low relative to previous drift waste surveys. It is recommended that a follow-up shoreline drift waste survey be carried out during the 1987 summer drilling season to determine if a shoreline cleanup program should be conducted. It is also recommended that improved waste management practices be implemented by industrial operators and that provisions for cleanup be included in offshore Environmental Operating Conditions (EOC's) when necessary. 18 refs 7 figs 2 tabs

41566 (PB–89-159735/XAB) **Evaluation of environmental information for the Unimak Pass Area, Alaska. Final report.** Truett, J.C.; Craig, P.C. LGL Ecological Research Associates, Inc., Bryan, TX (USA). Dec 1986. 386p. Available from NTIS, PC A19.

This report identifies and describes the important biological resources of the marine environment of the eastern Aleutian Islands, Alaska, between 164 and 170° W (herein called study area), and discusses the physical and chemical processes and components that support these resources. It evaluates the potential effects of oil and gas activities on the biota and identifies information needs. It is based solely on a review and analysis of existing information. Major points follow under the headings History of Investigation, Marine Mammals, Birds, Fish, Invertebrates, Primary Production, Physicochemical Processes, and Regional Comparisons and Potential Impacts.

41567 (PB–89-159750/XAB) **Outer Continental Shelf environmental assessment program. Final reports of principal investigators. Volume 59.** National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div. Dec 1988. 462p. Available from NTIS, PC A20/MF A01.

See PB–89-159768, PB–89-159776 and PB–89-159727. Portions of this document are not fully legible.

Contents include: ocean-ice/oil-weathering computer program user's manual; and development of a predictive model for the weathering of oil in the presence of sea ice.

41568 (PB–89-159768/XAB) **Ocean-ice/oil-weathering computer program user's manual. Final report.** Kirstein, B.E.; Redding, R.T. Science Applications International Corp., San Diego, CA (USA). Oct 1987. 142p. Available from NTIS, PC A20.

The ocean-ice/oil-weathering code is written in FORTRAN as a series of stand-alone subroutines that can easily be installed on most any computer. All of the trial-and-error routines, integration routines, and other special routines are written in the code so that nothing more than the normal system functions such as EXP are required. The code is user-interactive and requests input by prompting questions with suggested input. Therefore, the user can actually learn about the nature of crude oil and oil weathering by using this code. The ocean-ice oil-weathering model considers the following weathering processes: evaporation; dispersion (oil into water); moussee (water into oil); and spreading; These processes are used to predict the mass balance and composition of oil remaining in the slick as a function of time and environmental parameters.

41569 (PB–89-159776/XAB) **Development of a predictive model for the weathering of oil in the presence of sea ice. Final report.** Payne, J.R.; McNabb, G.D.; Hachmeister, L.E.; Kirstein, B.E.; Clayton, J.R. Science Applications International Corp., San Diego, CA (USA). Oct 1987. 314p. Available from NTIS, PC A20.

The objective of the program has been to develop a predictive model that describes the qualitative and quantitative weathering of spilled oil and refined petroleum products in the presence of first and multi-year ice. To achieve this objective and verify model predictions, cold-room and field experiments were performed to provide suitable data for describing time-series changes in the physical and chemical properties of oil spilled in the presence of first and multi-year ice in various configurations. For modeling purposes, fresh and weathered crude oil were characterized as distillable cut fractions. In addition, specific mechanisms for enhancing the transport of spilled oil components to the benthic environment were recognized during the program, and additional studies were completed to investigate these potentially significant dispersion/dissolution processes. Results from theses studies and the development of the computer model provide a significant contribution toward OCSEAP's goal of developing predictive capabilities for defining the magnitude of the impacts from OCS oil and gas activities to exposed Arctic and sub-Arctic biota.

41570 (PB–89-168157/XAB) **Oil-spill risk analysis: Central and Western Gulf of Mexico (Proposed Lease Sales 118 and 122) Outer Continental Shelf. Final report.** Hannon, L.J.; Lucas, A.D. Minerals Management Service, Reston, VA (USA). May 1988. 119p. (OCS/MMS–88/0025). Available from NTIS, PC A06/MF A01.

The Federal Government has proposed to offer Outer Continental Shelf lands off the Central and Western Gulf of Mexico for oil and gas leasing. The analysis characterizes the oil-spill risk associated with Gulf of Mexico Lease Sales 118 and 122. The probabilities of oil-spill occurrence and contact with land after 30 days for the Proposed Action are quite low. The highest values for the Central and Western Gulf of Mexico are 15% and 9%, respectively. The Proposed Action adds very little to the overall estimated risk (probabilities ranging from less than 0.5% to 15% for 30 days).

41571 (PB–89-169239/XAB) **Oil production in the Arctic National Wildlife Refuge: the technology and the Alaskan oil context.** Powers, L.M. Office of Technology Assessment (U.S.

Congress), Washington, DC (USA). Feb 1989. 130p. (OTA-E–394). Available from NTIS, PC A07/MF A01.

Also available from Supt. of Docs. Library of Congress catalog card no. 88-600565.

This report presents the results of an assessment of issues focusing on the oil-field technology being used to develop the Alaskan North Slope's oil resources and the likely configuration of that technology as it might be applied in the future to the coastal plain and the prospects for future North Slope oil production, especially the likelihood that the flow of oil through the Trans Alaskan Pipeline System will suffer a serious decline during the next decade.

41572 (PB–89-181028/XAB) **Offshore Texas and Louisiana marine ecosystem data synthesis.** Phillips, N.W.; James, B.M. Continental Shelf Associates, Inc., College Station, TX (USA). Nov 1988. 898p. Available from NTIS, PC EE99/MF E99.

Set includes PB–89-181036 through PB–89-181051.

A separate abstract is included for each of the 3 volumes of this set.

41573 (PB–89-181036/XAB) **Offshore Texas and Louisiana marine ecosystems data synthesis. Volume 1: Executive Summary. Final report.** Phillips, N.W.; James, B.M. Continental Shelf Associates, Inc., College Station, TX (USA). Nov 1988. 54p. Available from NTIS, PC A04/MF A01.

See also Volume 2, PB–89-181044 and Volume 3, PB–89-181051; Also available in set of 3 reports PC E99, PB–89-181028.

This study provided a synthesis of available environmental information for the continental shelf from the shallow sublittoral to a depth of 500 m for the area between Corpus Christi Bay, Texas and the Mississippi River Delta. Results of the study are given in three volumes: Executive Summary (Volume I), Synthesis Report (Volume II), and Annotated Bibliography (Volume III). The Synthesis Report consists of separate chapters devoted to marine geology, physical oceanography and meteorology, marine chemistry, marine biology, socioeconomics, and conceptual modeling of the area's major ecosystems with emphasis on the environmental effects of oil and gas operations. There is a summary of data gaps and information needs and suggestions for future field studies. The annotated bibliography, which contains 1,535 references, was compiled through a combination of computer searches, telephone contacts, library visits, and submissions from chapter authors. The bibliographic data set is presented in hard copy and on IBM-compatible floppy disks that have been indexed with a computer program (FYI 3000 Plus) to allow searching by author, date, topic and geographic keywords, or words in the title, source, or annotation.

41574 (PB–89-181044/XAB) **Offshore Texas and Louisiana marine ecosystems data synthesis. Volume 2: Synthesis report. Final report.** Phillips, N.W.; James, B.M. Continental Shelf Associates, Inc., College Station, TX (USA). Nov 1988. 516p. Available from NTIS, PC A22/MF A01.

See also Volume 1, PB–89-181036 and Volume 3, PB–89-181051; Also available in set of 3 reports PC E99, PB–89-181028.

This study provided a synthesis of available environmental information for the continental shelf from the shallow sublittoral to a depth of 500 m for the area between Corpus Christi Bay, Texas and the Mississippi River Delta. The Synthesis Report consists of separate chapters devoted to marine geology, physical oceanography and meteorology, marine chemistry, marine biology, socioeconomics, and conceptual modeling of the area's major ecosystems with emphasis on the environmental effects of oil and gas operations. There is a summary of data gaps and information needs and suggestions for future field studies.

41575 (PB–89-181051/XAB) **Offshore Texas and Louisiana marine ecosystem data synthesis. Volume 3: Annotated bibliography. Final report.** Phillips, N.W.; James, B.M. Continental Shelf Associates, Inc., College Station, TX (USA). Nov 1988. 329p. Available from NTIS, PC A15/MF A01.

See also Volume 2, PB–89-181044; Also available in set of 3 reports PC E99, PB–89-181028.

This study provided a synthesis of available environmental information for the continental shelf from the shallow sublittoral to a depth of 500 m for the area between Corpus Christi Bay, Texas and the Mississippi River Delta. The Annotated Bibliography, which contains 1,535 references, was compiled through a combination of computer searches, telephone contacts, library visits, and submissions from chapter authors. The bibliographic data set is presented in hard copy and on IBM-compatible floppy disks that have been indexed with a computer program (FYI 3000 Plus) to allow searching by author, data, topic and geographic keywords, or words in the title, source, or annotation.

41576 (PB–89-186621/XAB) **Industrial-hygiene survey report of Defense Fuel Support Point, Cincinnati, Ohio.** Piacitelli, G.; Krishnan, R. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). 9 Mar 1989. 23p. (IWS–134.20.14). Available from NTIS, PC A03/MF A01.

As part of a study of worker exposure, personal protective equipment, and engineering controls in use in work areas where exposure to ethylene glycol ethers is possible, an industrial hygiene survey was conducted at the Defense Fuel Support Point, Cincinnati, Ohio. The activities include receiving, storing, and distributing of jet fuel for military use. At the site, 2-methoxyethanol (2-ME) was added as an icing inhibitor to one of the jet fuels. JP-4 contained 0.10 to 0.15 wt.% of 2-ME and JP-5 contained diethylene-glycol-monomethyl-ether (DEGME) at a concentration of 0.15 to 0.20 wt.% received at the location for shipment elsewhere. The potential existed for inhalation and dermal exposure to 2-ME. Exposure controls included the use of engineering controls at the truck-loading operation and quality control analysis divisions and the wearing of personal protective equipment. Monitoring indicated that full-shift inhalation exposures to 2-ME were low, less than 0.34 part per million (ppm). Short-term exposures occasionally reached 6.86 ppm. Due to the small number of workers with a potential of exposure to glygol ethers, the facility should not be included in additional health studies. Specific recommendations are made for work practices, ventilation and personal protective equipment.

41577 (PB–89-186936/XAB) **Frontal Eddy Dynamics (FRED) experiment off North Carolina: Volume 1. Executive summary.** Ebbesmeyer, C.C. Evans-Hamilton, Inc., Seattle, WA (USA). Mar 1989. 19p. Available from NTIS, PC A03/MF A01.

See also PB–89-186944.

In preparation for oil and gas lease sales on the outer continental shelf offshore of North Carolina, the Minerals Management Service was requested to investigate the potential transport and impacts of oil spilled offshore. The Gulf Stream and associated eddies are an important aspect of the transport. Although the speed and location of the Gulf Stream are reasonably well known, knowledge of the meanders of the Gulf Stream is limited. How the circulatory structure and movement of associated frontal eddies and filaments affect the North Carolina coastal waters is not clear. This study investigates the interactions of these circulatory elements and follows the evolution of frontal eddies as they migrate along the North Carolina coast.

41578 (PB–89-186944/XAB) **Frontal Eddy Dynamics (FRED) experiment off North Carolina: Volume 2. Technical report.** Ebbesmeyer, C.C. Evans-Hamilton, Inc., Seattle, WA (USA). Mar 1988. 323p. Available from NTIS, PC A14/MF A01.

See also PB–89-186936.

In preparation for oil and gas lease sales on the outer continental shelf offshore of North Carolina, the Minerals Management Service was requested to investigate the potential transport and impacts of oil spilled offshore. Of particular concern is estimating the movement of spilled oil, especially the probability of shoreward transport and/or beaching of the floatable fraction. Although the speed and location of the Gulf Stream are well known, knowledge of the meanders of the Gulf Stream is limited. How the circulatory structure and movement of associated frontal eddies and filaments affect the North Carolina coastal waters is not clear. This present study investigates the interactions of these circulatory elements and follows the evolution of frontal eddies as they migrate along the North Carolina coast.

41579 (PB–89-861611/XAB) **Biodeterioration of oil spills. January 1970-April 1989 (Citations from the NTIS data base).**

Report for January 1970-April 1989. National Technical Information Service, Springfield, VA (USA). May 1989. 117p. Available from NTISPC N01/MF N01.

Supersedes PB–88-857594.

This bibliography contains citations concerning the degradation of petroleum products, including hydrocarbons, oil spills, and beach pollution. Microbial degradation of petroleum products on land, on the surface of the water, and underwater are discussed. Composting techniques and genetic engineering to facilitate oil degradation are briefly cited. The effect of cold climates on degradation speeds is studied. (This updated bibliography contains 213 citations, 13 of which are new entries to the previous edition.)

0210 Legislation and Regulation

41580 (SRBM–1987) **Manitoba surface rights board annual report, 1986-87.** Surface Rights Board, MB (Canada). 1988. 16p. (MICROLOG–87-06058). Available from Surface Rights Board, P.O. Box 158, Virden, MB, CAN R0M 2C0; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Manitoba Surface Rights Board is responsible for administering and enforcing the Surface Rights Act, the purposes of which include procedure for acquiring and utilizing surface rights, providing for the payment of compensation, and dispute resolution in connection with surface rights. It also provides for maintenance, preservation and restoration of the surface of land acquired in connection with surface rights. This report provides a summary of the year's activities of the Board in providing for the concerns of both landowners and the oil industry. Highlights of 1986-87 included 51 Board orders issued, 74 registered leases signed, 19 reviews of compensation applications settled, 8 right of entry applications settled, and 32 abandonment notices settled. This activity is low compared to previous years.

0230 Properties

Refer also to citation(s) 41628, 41631, 43259

41581 (AOSTRA–8808, pp. 12) **Improvements in the structural analysis of heavy petroleum fractions by NMR and related techniques.** Snape, C.E. (Univ. of Strathclyde, Glasgow, England). Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, 7-12 Aug 1988; CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Although nuclear magnetic resonance (NMR) has been widely used to deduce structural parameters for both coal-derived and heavy petroleum fractions, errors can arise from the inherent assumptions involved. This paper describes improvements made in assessing the nature of aromatic and aliphatic groups for asphaltene and neutral oil (aromatic) fractions through the use of ^{13}C spectral editing and two-dimensional methods. ^{13}C spectral editing enables concentrations of aromatic C and CH and aliphatic C, CH, CH_2, and CH_3 groups to be determined directly, while 2D methods resolve many aliphatic groups that give overlapping peaks in ^{1}H and ^{13}C spectra. These methods are illustrated by application to bitumens from Athabasca tar sands and Turkish asphaltites and to coal-derived oils. For aromatic groups, trends from NMR are consistent with those found by differential pulse voltammetry. Evidence is presented that suggests that naphthenic groups in petroleum heavy ends do not generally contain a large number of rings. The results obtained to date have enabled both petroleum and coal-derived asphaltenes to be defined empirically in terms of molecular mass, polarity, and the degree of condensation of aromatic groups. 31 refs., 5 figs., 4 tabs.

41582 (SGS–9 vp) **Families of oils in southeastern Saskatchewan.** Brooks, P.W. (Inst. of Sedimentary and Petroleum Geology, Calgary, AB, USA); Snowden, L.R.; Osadetz, K.G. Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5. international Williston Basin symposium, 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Three compositionally distinct families of oils are recognizable from 34 samples produced from a representative suite of pools in southeastern Saskatchewan. The families are characterized by gross geochemical and C_{15+} saturate hydrocarbon fraction compositions, obtained by gas chromatography and mass spectrometry-gas chromatography. One family of oils restructed to Ordovician pools, is characterized by low pristane/nC/sub17/and phytane/nC/sub18/ ratios, high diasterane/regular sterane ratios and low C/sub23/C_{30} terpane ratios. It is identical to the oils from Ordovician reservoirs in the American portion of the Williston Basin. Another family is characterized by cross-plots of the ratio of diasteranes/regular steranes against either the ration of saturate/aromatic hydrocarbons or the ratio of pristane/phytane. These oils are restricted to pools in the Birdbear Formation, the Bakken Formation and the Madison Group. The most abundant family of oils (22 pools) is identified by the same criteria, although they have low diasterane/regular sterane ratios and low pristane/phytane ratios in comparison. This family occurs in the Madison Group and younger reservoirs. A distinctive sub-group of oils in this family has high saturate/aromatic hydrocarbon ratios. Source rocks for the three families are suggested as an Ordovician source rock, the Bakken formation, and the Madison Group respectively. Other families of oils recognized in the American portion of the Williston Basin are not recognized in southeastern Saskatchewan. 43 refs., 8 figs., 3 tabs.

41583 Viscosities of alcohol-hydrocarbon systems in the critical region. Brunson, R.R. (9501898); Byers, C.H. *Journal of Chemical and Engineering Data (USA),* 34(1): 46-52 (Jan 1989).

The viscosities of pure alcohols and hydrocarbons, as well as binary mixtures of these compounds, were measured from room temperature to the critical region by use of a laser light scattering technique. Specially prepared monodispersed submicron silica particles were developed and used to achieve suspension stability into the critical region. The lower temperature data were verified by conventional techniques and by comparison with reliable literature data. In both pure materials and mixtures, the Andrade correlation is clearly not applicable over a wide temperature range. Excess viscosity indicates expected disruption of hydrogen-bonding networks by the hydrocarbons in alcohols.

41584 Transient interfacial tension behavior of crude-oil/caustic interfaces. Sharma, M.M. (9501086); Jang, L.K.; Yen, T.F. *SPE (Society of Petroleum Engineers) Reservoir Engineering (USA),* 4(2): 228-236 (May 1989).

A systematic study is conducted to describe the transient interfacial tension (IFT) behavior of crude-oil/caustic interfaces. The variation in this behavior with variation in the composition of the aqueous phase and other parameters is the focus of this study. It is found that at low pH values, the experimentally observed behavior is similar to that reported earlier. At high pH values, however, a maximum in IFT is observed, followed by a minimum at a late time. Sodium chloride is shown to have no significant effect on the shape of the transient IFT curve, but the absolute values of IFT are at lower NaCl concentrations. Divalent ions dramatically increase the IFT. A chemical model that takes into account the kinetics and the detailed chemistry of the process is used to explain the observed phenomena. The phenomenological surface phase approach is used to model the interface. The resultant set of ordinary differential equations is linearized by making certain justifiable, simplifying assumptions. The analytical solution to the set of equations yields the variation of the various concentrations with time. The IFT is then related to the interfacial concentration of the surface-active species, A_s^-, by the Gibbs equation. The variation in the transient IFT behavior on changing the kinetic constants, phase volumes, and ionic concentrations is discussed. Finally it is shown that the extension of this model to a two-component model would successfully explain all the experimentally observed phenomena.

0240 Storage

41585 (EPS–2/PN/1) **Detection, prevention, and remediation of leaks from underground storage tanks.** Environment Canada, Ottawa, ON (Canada). Conservation and Protection. 1989. 85p. (MICROLOG–89-02223). Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Steel tanks have been used for underground storage of petroleum products and derivatives for about 30 years. The oldest tanks have now exceeded their design life and product leaks related to corrosion are increasing. The length of the tank's life is one of several factors that could result in a petroleum product leak. These leaks can contaminate soil and water in the immediate surroundings. The different recovery and treatment techniques applicable to hydrocarbon contaminated soil and water due to underground storage tank leaks are summarized in this report. Detection and prevention are briefly discussed and some examples of available equipment are given. A list of suppliers of pollution control equipment is also given. 53 refs., 16 figs., 12 tabs.

41586 (EPS–2/PN/1-F) **Detection, prevention, and remediation of leaks from underground storage tanks.** Environment Canada, Ottawa, ON (Canada). Conservation and Protection. 1989. 93p. (In French). (MICROLOG–89-02224). Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

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0250 Combustion

41587 (AD-A–207009/2/XAB) **Fuel-rich catalytic combustion of Jet-A fuel - equivalence ratios 5.0 to 8.0. Technical memo.** Brabbs, T.A.; Gracia-Salcedo, C.M. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1988. 10p. (NASA-E–4675). Available from NTIS, PC A02/MF A01.

Fuel-rich catalytic combustion (E. R. > 5.0) is a unique technique for preheating a hydrocarbon fuel to temperatures much higher than those obtained by conventional heat exchangers. In addition to producing very reactive molecules, the process upgrades the structure of the fuel by the formation of hydrogen and smaller hydrocarbons and produces a cleaner-burning fuel by removing some of the fuel carbon from the soot formation chain. Temperatures higher than the 1200 K measured in a previous study with iso-octane can be obtained by altering the air inlet temperature and/or the equivalence ratio (E. R.). The maximum temperature for the processed gases is probably 1350 K which is the threshold temperature for the formation of soot. This paper will describe the successful application of fuel-rich catalytic combustion to Jet-A, multicomponent fuel used in gas-turbine combustors.

03 NATURAL GAS

Refer also to citation(s) 41504

41588 (ENEA-RT-TIB–86-34) **Gases of energy and environment-related interest: general properties and analytical methods.** Bimbi, L.; Fabiani, C.; Pizzichini, M.; Visentin, L. ENEA, Casaccia (Italy). Dipt. Tecnologie Intersettorialli di Base. Nov 1986. 127p. (In Italian). Order Number DE89761913/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

This report gives some information and data about important gases relative to energy and environment-related problems. The gases classified are CH_4, CO_2, H_2S, CO, H_2, COS, SO_2, PH_3, O_2, N_2, NO, N_2O, N_2O_4. A consultation manual is developed providing information with regard to the gases chemical characteristics, methods of chemical analysis (e.g. gas chromatography), storage and handling techniques. Particular attention is given to biological gases produced by anaerobic digestion.

0301 Reserves

Refer also to citation(s) 41617

41589 (PB–89-189385/XAB) **Report on the GRI (Gas Research Institute) workshop on reservoir modeling and two-phase flow.** CER Corp., Las Vegas, NV (USA). 8 May 1987. 252p. Available from NTIS, PC A12/MF A01.

GRI held a workshop on April 27, 1987 to discuss state-of-the-art technology used to simulate reservoir behavior and to investigate planning strategy for future GRI research activities in reservoir modeling, specifically the complexities of modeling multi-phase flow. During the morning session GRI contractors involved with reservoir simulators and related research made brief presentations on their research activities. The afternoon session was an informal group discussion designed to address future research needs. The summary prepared by each presenter is provided, along with presentation material from slides and/or overheads. Written comments by attendees about the workshop are included.

0302 Geology and Exploration

Refer also to citation(s) 41506, 41509, 41517, 41612

41590 (DOE/MC/21179–2710) **Rock matrix and fracture analysis of flow in western tight gas sands—Phase 4: 1988 Annual report.** Morrow, N.R.; Buckley, J.S.; Cather, M.; Brower, K.R.; Bretz, R.; Gonzales, B.; Graham, M.; Kinner, R.; Ma, S.; Voigt, B.; Zhang, X. New Mexico Inst. of Mining and Technology, Socorro, NM (USA). New Mexico Petroleum Recovery Research Center. Feb 1989. 69p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-84MC21179. Order Number DE89000995/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The objective of this project is to develop reliable methods of advanced core analysis for measuring the petrophysical properties of tight gas sands. Using advanced core analysis techniques we hope to define better the interrelationships between rock composition, pore structure and distribution, and flow properties. We also hope to determine the effects of water saturation and confining pressure on fluid flow through the low-permeability rock matrix, healed tectonic fractures, and fractures induced along preexisting planes of weakness. 19 refs., 34 figs., 9 tabs.

41591 (DOE/MC/21181–1950-Vol.13) **Geological evolution and analysis of confirmed or suspected gas hydrate localities: Volume 13: Basin analysis, formation and stability of gas hydrates of the Nankai Trough: Topical report.** Ciesnik, M.; Krason, J. Geoexplorers International, Inc., Denver, CO (USA). May 1989. 78p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-84MC21181. Order Number DE89011674/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Geological factors controlling the formation, stability, and distribution of gas hydrates were investigated by basin analysis of the Nankai Trough region. The Nankai Trough is located beneath the western Pacific, south of the Japanese islands Shikoku and central Kyushu. Geological, geophysical, and geochemical data from the region were assembled and critically evaluated to develop consistent interpretations of the relationships of geological environments and gas hydrates. This study was performed for the US Department of Energy Morgantown Energy Technology Center by Geoexplorers International, Inc., as part of a worldwide evaluation of 21 offshore sites where the presence of gas hydrates has been confirmed or inferred. 60 refs., 26 figs., 1 tab.

41592 (PB–89-188916/XAB) **Exploration-production studies in newly drilled Devonian shale gas wells. Annual report, February-1988-January 1989.** Graham, R.L.; Foster, J.; Amick, P.; Worthington, J. Graham (Reuben L.), Inc., Charleston, WV (USA). Feb 1989. 56p. Available from NTIS, PC A04/MF A01.

See also PB–88-203203.

This cooperative program is part of a continuing field-oriented effort whose objectives are to identify productive gas zones, to develop a comprehensive set of diagnostics, and to determine the effectiveness of various stimulation techniques. To date, the program has encompassed 71 cooperative wells and 15 participating producers with outside funding in excess of 10 million dollars. The program has progressed from the identification of productive zones, through the development of more-effective diagnostics and evaluations, and into the improvement of various stimulation techniques.

0303 Drilling, Production, and Processing

Refer also to citation(s) 41592, 42268, 43039

41593 **Assessment of gas production potential from strata above longwall mining.** Layne, A.W. (Dept. of Energy, Morgantown (USA)); Siriwardane, H.J.; Byrer, C.W. *AAPG (American Association of Petroleum Geologists) Bulletin (USA),* 72(8): 966 (Aug 1988). (CONF-8809345–: AAPG Eastern section meeting, 13-15 Sep 1988).

Pipeline-quality gas production potential from the highly fractures methane-bearing strata above longwall coal mine panels may be many times that of the gas-in-place estimate for the minable coal bed. The permeability in these strata is increased significantly due to the fractured zone generated during longwall mining activity. This paper assesses the potential production and influence of well spacing for drainage of gas from the strata above coal mine panels. Reserves were quantified by use of the predicted extent of the failure zone, the formation gas contents, and geologic cross sections from throughout the Appalachian basin. A finite element method was used to determine the size and shape of the affected stratigraphic areas and gas contents were derived.

0304 Products and By-products

41594 (NEI-NO–87 G9 16) **Technical/commercial review of the development of middle distillate synthesis from natural gas.** Bekker (Shell International Gas Ltd., London); G.A.; Oerlemans, T.W. Norsk Petroleumsforening, Oslo (Norway). 1988. (CONF-8808151–: Offshore northern seas conference and exhibition, 23-26 Aug 1988). In *Gas utilization.* Order Number DE89776213/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Via the conversion of natural gas into very high quality, liquid hydrocarbons, Shell Middle Distillate Synthesis technology provides a new means of utilising natural gas, especially that which is remote from the market. For countries with abundant gas reserves and limited or no oil reserves it further allows the reduction of imports of oil and oil products. The technology encompasses the conversion of natural gas into synthesis gas which, using a modern version of the Fischer-Tropsch process, is converted into long chain paraffinic waxes. In a subsequent step these are converted into desired products. The process based on this technology, essentially produces gasoil, kerosene and some naphta, the quality and blending properties of which are excellent. Moreover, if so desired, other high value products also can be manufactured, such as paraffinic solvents and base chemicals. 3 figs.

0305 Health and Safety

41595 (CPS–8702, pp. 137-147) **What is a BLEV?.** McDevitt, C.A. (Univ. of New Brunswick, NB, Canada); Stewart, F.R.; Venart, J.E.S. Environnement Canada, Ottawa, ON (Canada). Conservation et Protection. 1987. (CONF-870295–: Technical seminar on chemical spills, Toronto (Canada), 9-12 Feb 1987; MICROLOG–87-01873). In *Proceedings [of the] 4th technical seminar on chemical spills.* Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Loss of containment of liquified gases or of pressurized liquids at a temperature above their normal boiling point can result in a BLEVE - a Boiling Liquid Expanding Vapour Explosion. Classic and recent examples of this phenomenon are reviewed. The main theories on the causes of a BLEVE are discussed in light of recent incidents. Comments are made on current literature discussion about the definition of a BLEVE. Research about the mechanism of BLEVEs conducted at the University of New Brunswick is reviewed. Of particular concern is whether the flammability of the tank contents is a factor. The possibility that BLEVEs may be prevented by keeping the container below the pressure associated with the superheat temperature limit is also of interest. Experimental results are presented. 18 refs., 6 figs., 2 tabs.

41596 (PB–89-185870/XAB) **Environment and Safety Research Program status report: 1988-1989.** Gas Research Inst., Chicago, IL (USA). Mar 1989. 164p. (GRI–89/0081). Available from NTIS, PC A08/MF A01.

See also PB–88-210620.

This document discusses the status of ongoing and planned research activities in GRI's Environment and Safety Research Program. Activities within the program are divided into three subprograms (Supply, End Use, and Gas Operations) and each subprogram has multiple project areas. The basis, objectives and goals, accomplishments, and strategy of each project area are presented. Reports summarizing the status of each active research contract are included.

0306 Marketing and Economics

Refer also to citation(s) 41555, 41557, 41558, 41559, 41607, 41608, 42219, 42315

41597 (DOE/EIA–0130(89/05)) **Natural gas monthly, May 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 31 Jul 1989. 155p. Sponsored by U.S. DOE Management & Administration. Order Number DE89016458/JAW. Available from NTIS, PC A08/MF A01 - GPO - OSTI; GPO Dep.

This publication highlights activities, events, and analyses of interest to public and private sector organizations associated with the natural gas industry. Volume and price data are presented each month for natural gas production, distribution, consumption, and interstate pipeline activities. Producer-related activities and underground storage data are also reported. From time to time, the NGM features articles designed to assist readers in using and interpreting natural gas information. Explanatory Notes supplement the information found in the report's tables. A description of the data collection surveys that support the NGM is provided in the Data Sources section. A glossary of the terms used in this report is also provided to assist readers in understanding the data presented in this publication. All natural gas volumes are reported at a pressure base of 14.73 pounds per square inch absolute (psia) and at 60 degrees Fahrenheit. 6 figs., 33 tabs.

41598 (NEB–GH-5-88) **Alberta and Southern Gas Co. Ltd. Reasons for decision.** National Energy Board, Ottawa, ON (Canada). 1989. 21p. (CE–02690). Available from National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, ON, CAN K1A 0E5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report details the process and decisions following an application by Alberta and Southern Gas Co. Ltd. requesting the National Energy Board pursuant to amend a natural gas export licence. The Board may license for export only those volumes of natural gas that do not exceed the surplus remaining after making due allowance for reasonably foreseeable Canadian requirements, taking into account trends in discovery. The Applicant indicated that the applied-for exports would not cause Canadians difficulty in meeting their energy requirements at fair market prices. The benefit-cost analysis indicated positive net benefits to Canada. With respect to gas supply,

the Board is satisfied that the Applicant has available sufficient productive capacity from existing established reserves to meet its requirements until 1995. The Board concluded that an export licence to 2005 would provide the Applicant with sufficient long-term security to pay for facilities and to successfully compete for supply and market. It decided to issue a new licence for the requested volumes for the period November 1, 1994 to October 31, 2005. 1 fig., 7 tabs.

41599 (NEB–GH-5-88-F) **Alberta and Southern Gas Co. Ltd.. Reasons for decision.** National Energy Board, Ottawa, ON (Canada). 1989. 21p. (In French). (CE–02688). Available from National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, ON, CAN K1A 0E5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

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41600 (NEI-NO–84 F6 34) **Gas market structures in Western Europe.** Bergmann, B. (Ruhrgas AG, Essen (West Germany)). Norsk Petroleumsforening, Oslo (Norway). 1988. (CONF-8808151–: Offshore northern seas conference and exhibition, 23-26 Aug 1988). In *General conference*. Order Number DE89776210/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Competitively-priced natural gas will strengthen its position on the European energy market by growing moderately in the mature markets and making stronger inroads in the young and the incipient markets. For Norway, this provides an opportunity to double its supplies to meet European gas demand to 40 to 45 Mtoe over the next 20 years, even if natural gas should not gain a firmer foothold in the power station sector outside Scandinavia. Inroads in the power station sector appear possible on the basis of the current price relationship, but forecasts must be carefully assessed against the backdrop of possible future changes in price relations. Even considering the temporary surplus in energy supplies available, long-term energy supplies present too great a challenge for us to place at risk the future of natural gas, the only uncomplicated source of energy, by political decisions, be it in the form of structural changes in the gas industry, or be it by fiscal measures. Any change must be weighed up, balancing the opportunities against the risks. It is not always best to act, but sometimes it is better to leave things as they are. 11 figs., 1 tab.

41601 (PB–89-175335/XAB) **Applications study and research-needs assessment for natural gas use for waste management. Topical report, Jjanuary 1988-January 1989.** Seeker, W.R.; Heap, M.P.; Landrum, V.; Lanier, W.S. Energy and Environmental Research Corp., Irvine, CA (USA). Jan 1989. 167p. Available from NTIS, PC A08/MF A01.

The study was concerned with the potential for natural gas use in the area of waste management in the United States. Five major waste categories were considered as follows: (1) refuse materials (including municipal, industrial and medical), (2) hazardous wastes, (3) site remediation materials, (4) sewage sludge and (5) industrial non-hazardous waste (including volatile organic carbon, metal processing wastes, and others). The current and emerging regulations which dictate the treatment requirements for each of these waste streams were analyzed, together with the current disposal technologies. From the comparison of available technologies with future regulations, technology needs and potential gas-based technologies were defined. Potential gas loads and research and development needed to apply gas based technologies were identified.

41602 (PB–89-194005/XAB) **GRI's (Gas Research Institute's) Gas Appliance Technology Center: 1988 annual report (activity at Battelle). Annual report, January 1, 1988-January 31, 1989.** Locklin, D.W. Battelle Columbus Div., OH (USA). Mar 1989. 79p. Available from NTIS, PC A05/MF A01.

See also PB–88-210638.

The goal of GRI's Gas Appliance Technology Center (GATC) is to encourage the introduction of highly efficient, cost-effective, convenient gas appliances for residential and commercial gas users. The report covers activity at Battelle during 1988 in broad support tasks, residential space conditioning, and residential and commercial appliances. Broad support tasks included the G/A/S Newsletter; the GATC InfoBase; and technology transfer, workshops, and GATC coordination. Residential space conditioning tasks included developing a corrosion test methodology for gas-fired furnaces, testing nonmetallic materials for condensing heat exchangers, and assessing the technology for self-powered appliances. Tasks involving residential appliances included burner technology and applications, conceptual appliances, and gas lighting. These tasks are briefly described in the report, with references to publications that provide additional detail.

0308 Environmental Aspects

Refer also to citation(s) 41566, 41570, 41572, 41573, 41574, 41575, 41577, 41578, 43472, 43473, 43474, 43475, 43476

41603 (PB–89-186035/XAB) **Computer data base of emissions data for stationary reciprocating natural gas engines and gas turbines in use by the gas-pipeline-transmission industry. User's manual. Topical report, May 1987-February 1989.** Martin, N.L.; Thring, R.H. Southwest Research Inst., San Antonio, TX (USA). Feb 1989. 111p. (SWRI–1781/201). Available from NTIS, PC A06/MF A01.

For system on diskette, see PB–89-186027.

This document is a user's manual for a computer data base of emissions data for stationary reciprocating natural gas engines and gas turbines in use by the Gas Pipeline Transmission Industry. The data base contains both emissions and performance data taken from in-service natural gas engines. The data base is designed to be operated as an IBM compatible personal computer, and a disk is provided in the back pocket of the document.

0309 Artificial Stimulation

Refer also to citation(s) 41543

41504 (PB–89-181143/XAB) **CO_2 sources for methane synthesis. Topical report No. 1, February 1988-March 1989.** Feinberg, D.A.; Karpuk, M.E. TDA Research, Inc., Wheat Ridge, CO (USA). Mar 1989. 56p. (TDA–89-GRI-001). Available from NTIS, PC A04/MF A01.

This study seeks to identify low-cost sources of CO_2 for electrochemical or photoelectrochemical synthesis of methane for the fuel market. The amount of CO_2 required is potentially much larger than currently recovered and sold in the commercially but is comparable to the anticipated need for enhanced oil recovery. By 2010, coal gasification could become a widely-used process for the clean utilization of coal for the production of electricity and synthetic fuels. Recovery of high pressure, concentrated CO_2 from coal gasification offers the most promise of all sources analyzed. Concentrated CO_2 is also available as a by-product from the anaerobic digestion of biomass by methanogenic bacteria. Naturally occurring CO_2 is also a significant potential source, but may be used elsewhere and therefore unavailable for methane synthesis. Recovery of CO_2 from dilute sources, such as cement plants and the flue gas of power plants, is not expected to be cost-effective for methane synthesis. The cost of transporting CO_2 can be significant. Supercritical pipelines are the most economical method of transporting CO_2 at the flowrates required for methane synthesis. Transportation of CO_2 is feasible only from large concentrated sources over relatively short distances.

41605 (PB–89-188882/XAB) **Geologic assessment of natural gas from coal seams in the Central Appalachian Basin. Topical**

report, January-November 1988. Kelafant, J.R.; Boyer, C.M. ICF-Lewin Energy, Fairfax, VA (USA). Dec 1988. 97p. Available from NTIS, PC A05/MF A01.

See also PB–88-232640.

The analysis of the subsurface geology of six Pennsylvanian-age coal seams was undertaken to estimate coal volumes present in the Central Appalachian Basin. Correlations relating gas content of the basin coal beds to rank and depth of burial were derived to estimate gas in place. Results of the geologic analysis indicate the natural gas in place in the basin is 5 trillion cubic feet (Tcf). The Pocahontas No. 3 coal seam represents the largest potential coalbed methane resource with 1.6 Tcf of gas in place. Included in the report are five regional cross sections, overburden and isopach maps, coal rank maps, and the correlations of gas content to coal rank and depth of burial.

41606 (PB–89-194021/XAB) **Application of hydrology to evaluation of coalbed methane reservoirs. Topical report, January 1967-December 1988.** Koenig, R.A.; Bumb, A.C.; McKee, C.R.; Murphy, C.L.; Ramesh, M.S. In-Situ, Inc., Laramie, WY (USA). Mar 1989. 123p. Available from NTIS, PC A06/MF A01.

Coal seams have unique properties that make conventional production methods for gas-sand reservoirs ineffective. A systematic approach to selecting and developing a site using hydrologic concepts and well-testing techniques is presented. The most significant factors influencing methane production include adsorption, dewatering, gas desorption, two-phase flow of gas and water, and optimal wellfield patterns. New techniques are described for situations outside the realm of conventional reservoir engineering methods. The principal methods have been incorporated in PC software. The three stages of fluid flow from a coal seam to a well-bore are analyzed as 'windows' for determining critical reservoir properties. The most important parameters controlling production in a coal seam with adequate gas content are gas desorption pressure, permeability-thickness, and static reservoir pressure. Gas content and seam thickness are readily derived from drilling and core samples, and desorption pressure can be derived simply from a controlled drawdown test. A low-cost, easily applied procedure called a STEP Test was devised to determine permeability and static-reservoir pressure along with the condition of the wellbore.

0310 Legislation and Regulation

Refer also to citation(s) 41598, 41599, 41609, 41610

41607 (NEB–GH-3-89) **Reasons for decision in the matter of Amoco Canada Petroleum Co. Ltd.** National Energy Board, Ottawa, ON (Canada). 1989. 9p. (CE–02699). Available from National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, ON, CAN K1A 0E5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

By its application dated 12 January 1989, Amoco Canada Petroleum Co. Ltd. sought a licence to export natural gas to the United States at Huntingdon, British Colum bia. Amoco will sell the gas to Washington Natural Gas Company for its system supply requirements in northwestern Washington State. The reasons for the decision taken are discussed, including cost-benefit analyses from the point of view of Canada. The licence is granted, subject to approval by the Governor in Council, until 31 October 2004. The quantities exported shall not exceed 0.704 M m^3/d (with a tolerance of 2%), 257 M m^3/y, and 3.856 Gm^3 during the term of this licence. 4 tabs.

41608 (NEB-SS–GH-3-89-F) **Reasons for decision in the matter of Amoco Canada Petroleum Co. Ltd.** National Energy Board, Ottawa, ON (Canada). 1989. 11p. (In French). (CE–02700). Available from National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, ON, CAN K1A 0E5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

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0320 Transport, Pipelines, and Handling

Refer also to citation(s) 41598, 41599

41609 (NEB–MH-2-88) **North Canadian Oils Limited. Reasons for decision.** National Energy Board, Ottawa, ON (Canada). 1989. 24p. (CE–02687). Available from National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, ON, CAN K1A 0E5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report details the process and decisions following an application by Foothills Pipe Lines (Yukon) Ltd. to receive, transport, and deliver gas offered by North Canadian Oils Limited (NCO) for transportation through the Foothills system from either McNeil, Alberta, and/or Piapot, Saskatchewan, to Monchy, Saskatchewan. Foothills had instituted a queue for requests for firm service. The potential shippers in the queue were required to meet certain criteria of acceptance of access criteria before they could obtain access to the available firm capacity. All that was required from a potential shipper to be placed in its queue for firm service was a written request specifying the volume and the term of the proposed service. A potential shipper's position in the queue was determined by the date of the written request. Capacity was to be then allocated among potential shippers who could meet the access criteria by a specified date. The Board expects that Foothills will consult with existing shippers who have firm and interruptible transportation service on its system, and with potential shippers who have requested firm service, prior to filing the documents with the Board. NCO has met the access criteria that the Board has found reasonable for requests for existing capacity, and the Board is satisfied that sufficient capacity will exist with the installation of a new station to accommodate the requested volumes. 1 fig., 1 tab.

41610 (NEB–MH-2-88-F) **North Canadian Oils Limited. Reasons for decision.** National Energy Board, Ottawa, ON (Canada). 1989. 25p. (In French). (CE–02689). Available from National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, ON, CAN K1A 0E5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

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41611 (NEI-NO–87 G3 13) **Gas energy transport and distribution. Pipeline or wire?.** Lorentzen, G. (Norges tekniske hoegskole, Trondheim, (Norway)). Norsk Petroleumsforening, Oslo (Norway). 1988. (CONF-8808151–: Offshore northern seas conference and exhibition, 23-26 Aug 1988). In *Gas utilization.* Order

Number DE89776213/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

To provide sufficient energy to assure acceptable living conditions for the world's growing population, without unacceptable harm to the environment, is the most pressing predicament for the future. If we do not succeed, all other plans will be futile. An end use analysis shows that the energy requirement in general consumption as well as for most industries is best covered by electricity. This makes possible a substantial saving in primary fuel consumption and has important advantages in environmental protection and convenience as well. Local distribution will be by wire, and a double system by parallel installation of a gas grid is uneconomical and anachronistic. The choise of carrier for exergy transportation from the gas source to the centres of consumption is less obvious. Strong arguments favour location of the gas power plants near the source and distribution through the electric trunk line system. 3 figs., 1 tab.

0330 Properties

Refer also to citation(s) 42218, 43273

41612 (AU/P–U-30) **Stable isotope research in support of more effective utilization of gas fields in Alberta. Final report.** Krouse, H.R. Alberta Univ., Edmonton, AB (Canada). Dept. of Physics. 1983. vp. (CE–02673). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

Carbon and hydrogen isotope data were obtained for gas samples in Alberta over a wide range of depths down to 400 m. The chemical compositions ranged from shallow dry biogenic gas (Medicine Hat Field) through oil associated gas (Devonian) to dry deep thermal gas (Deep Basin). A number of chemical and isotopic parameters show fairly abrupt transitions at about 1000 m depth. This is interpreted as representing the lower limit for shallow biological processes and the dominance of thermal conversions in deeper strata. A preparatory gas chromatograph-combustion line-mass spectrometer combination was developed during the course of the study. A data base was set up to establish an isotopic inventory for gas wells in Alberta and to test relationships among isotopic data and other parameters. Desirable future research and applications are briefly discussed. 75 refs., 76 figs., 2 tabs.

41613 (PTB-W–37, pp. 99-104) **Determining gas data from chromatography analysis.** Krabbe, H.J. (Vereinigte Elektrizitaetswerke Westfalen AG (VEW), Bochum (Germany, F.R.)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Waerme. Jun 1988. (In German). (CONF-8712127–: 67. PTB-seminar on state and development of gas calorimetry and charging for heating gas, Braunschweig (Germany, F.R.), 10-11 Dec 1987). In *State and development of gas calorimetry and charging for heating gas. Proceedings.* Order Number DE89795859/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

One of the parameters in the gas economy relevant for charging is the calorific value. It can be determined by burning the gas in a calorimeter and by calculation from the components of natural gas determined by gas chromatography. There is a report on the gas chromatography analysis technique and the calculation of the calorific value from these components and a comparison with calorimetric data. In gas chromatography, the gas to be tested reaches the analytical separation column with a carrier gas. The individual components leave the column at different times. A detector situated at the end of the separation column supplies signals corresponding to the course of concentration. The individual gas analysis steps (propane as reference gas, determination of argon, methane, nitrogen) and the calculation of the calorific value made clear by mathematical formulae are explained. Overall, it is found that gas chromatography analysis can be used to determine the calorific value. (HWJ).

41614 (PTB-W–37, pp. 135-144) **First experience with the computer-aided assignment of calorific values by the GRANPRODA program system.** Herr, E. (Salzgitter Ferngas G.m.b.H. (Germany, F.R.)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Waerme. Jun 1988. (In German). (CONF-8712127–: 67. PTB-seminar on state and development of gas calorimetry and charging for heating gas, Braunschweig (Germany, F.R.), 10-11 Dec 1987). In *State and development of gas calorimetry and charging for heating gas. Proceedings.* Order Number DE89795859/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01.

The program system GANPRODA was used to determine the calorific values at the output positions of a 1000 km long natural gas network. The calorific value was calculated based on the calibrated calorific value measurements at the infeed positions, using all the parameters of the gas distribution process (including gas density, compressibility, pipeline diameter, roughness of pipeline). The daily average calorific value is calculated from 24 hour mean values. Experience is described with reference to complying with the Calibration Office requirements (reference calorimeter, sampler, inspection of pressure transducer) and on operating experience (calculation of calorific value, early recognition of errors of measurement, network control). This program system has proved easy to handle and stable in operation. (HWJ).

41615 (PTB-W–37, pp. 145-154) **Assignment of calorific value with the aid of identification measuring positions.** Friedrichs, W. (Thyssengas G.m.b.H., Duisburg (Germany, F.R.)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Waerme. Jun 1988. (In German). (CONF-8712127–: 67. PTB-seminar on state and development of gas calorimetry and charging for heating gas, Braunschweig (Germany, F.R.), 10-11 Dec 1987). In *State and development of gas calorimetry and charging for heating gas. Proceedings.* Order Number DE89795859/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01.

In a gas transport network, in which the gas calorific values vary (oscillating zones), there will be problems in application and calculation technique. There are several possibilities of limiting the charging problems: splitting the areas, conditioning and calculation processes. There are reports on these three possibilities, particularly on computer-aided identification measurement positions (gas parameters: density, O_2 and CO_2 content). Data are given on the build-up of such an identification measurement equipment (gas density scales, CO_2 and O_2 measurement equipment), its method of operation (data recording, forming mean values, program calibration) evaluation (daily date file, emitted graphically and in tables) and the costs. From previous experience, it seems possible to use this identification process even in complicated cases (e.g. quality of mixture). (HWJ).

0340 Combustion

Refer also to citation(s) 41914, 41915, 41916, 42316, 42317, 42433, 42513

41616 (PB–89-188874/XAB) **Catalytic combustion of methane. Annual report, May 15, 1987-May 15, 1988.** Pfefferle, L.D.; Smooke, M.D. Yale Univ., New Haven, CT (USA). Dept. of Chemical Engineering. Mar 1989. 85p. Available from NTIS, PC A05/MF A01.

See also PB–88-123112.

Catalytically stabilized combustion represents an extremely promising but underexploited technology. Catalytic combustors can be designed to combine the high reaction rates of thermal combustors with the low NOx and soot levels of conventional catalytic oxidation reactors. This GRI-sponsored research focuses on examining the basic chemical and transport mechanisms from a fundamental point of view with the objective of determining how these mechanisms affect design considerations. This report summarizes findings with respect to the effect of a platinum catalyst on the concentration of oxidizing radicals (O, OH) in a combustion boundary layer and the relation of this effect to gas-phase ignition criteria. The authors also report results from the reacting boundary-layer model for combustion of hydrogen over reactive and nonreactive surfaces. Thermal diffusion, complex chemistry in the gas phase, surface oxidation of hydrogen, and surface production of OH were considered.

0350 Storage

41617 (PB–89-188866/XAB) **Development of improved technologies and techniques for reducing base gas requirements in underground natural gas storage facilities: mathematical model. Final report, December 1987-December 1988.** Modine, A.D.; Graue, D.J. Scientific Software Corp., Denver, CO (USA). Mar 1989. 141p. Available from NTIS, PC A07/MF A01.

See also PB–89-136170.

Base-gas requirements in the U.S. amount to a few trillion cubic feet. The Gas Research Institute has proposed a gas-storage operating plan whereby an inert gas or a low-BTU gas could be injected to replace part of the hydrocarbon gas. A reservoir simulator was developed to solve gas-water reservoir problems where the gas may be treated as a two-component miscible mixture. The previously developed reservoir simulator was tested on a variety of cases. They covered software performance and interpretive questions regarding the performance of gas-storage reservoirs with inert-gas injection. The cross section and areal field-wide cases studied gave significant insights into optimum gas-storage operations. The calculation efficiency of the previous model was improved by the development of an advanced dispersion calculation, called the Generalized Koval method, which was incorporated into the model Omega. The model was documented in a User's Manual.

04 OIL SHALES AND TAR SANDS

Refer also to citation(s) 41504

41618 (AOSTRA–8808) **UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 4.** Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. vp. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton (Canada), 7-12 Aug 1988; CE–02658). Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The major topics covered in these proceedings include the recovery of heavy oil from oil sands; the upgrading of heavy oils by catalytic hydrocracking; technical and economic studies of the upgrading of heavy oil residues to produce diesel and jet fuels; and the co-processing of coal and heavy oil residues to produce synthetic petroleum. Other subjects are the geophysical survey methods and the core analysis techniques to be applied to oil sands, and the structural chemical analysis of heavy oil products and coal-derived liquids. Separate abstracts have been prepared for 33 papers from this symposium.

0401 Reserves and Exploration

Refer also to citation(s) 41628

41619 (AOSTRA–8808, pp. 21) **Seismic velocities in heavy oil and tar sands. The basis for in-situ recovery monitoring.** Wang, Z. (Stanford Univ., Stanford, CA, USA); Nur, A.M. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, 7-12 Aug 1988; CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Wave velocities versus temperature were measured in heavy oils, tars, heavy oil and tar sands in the laboratory. The experimental results show that the velocities in both the heavy hydrocarbons and the sands are strongly dependent on temperature. As temperature increases by 100^{0}C, the compressional wave velocity versus temperature typically decreases by 10 to 15% in well-consolidated heavy oil sandstones, and by 14 to 40%, even up to 60% in unconsolidated heavy oil and tar sands. The temperature dependence of the velocities is interpreted in terms of the phase transition of the heavy hydrocarbons and high pore pressure generated by the thermal expansion of the hydrocarbons. The strong temperature dependence of seismic wave velocities in heavy oil and tar sands appears to be directly related to the presence of the heavy hydrocarbons, so that the effect is anticipated to occur also in situ. If so, remote seismic methods can be used to continuously monitor reservoirs throughout the thermal enhanced oil processes, such as to track fire or steam fronts and to map the flooded zones. 9 refs., 13 figs., 1 tab.

41620 (AOSTRA–8808, pp. 14) **Seismic characterization of thermal flood behaviour.** den Boer, L.D (Western Atlas International); Matthews, L.W. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, 7-12 Aug 1988; CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In the past several years, laboratory studies of the temperature dependence of acoustic velocity and in situ monitoring tests at active thermal pilots have proven the concept of seismic monitoring to track the horizontal extent of thermal fronts in the subsurface. Laboratory experiments have shown that a decrease in acoustic velocity as large as 30% can be caused by heating a sample saturated with heavy oil to 150^{0}C under reservoir conditions. This velocity decrease implies both a time delay and an amplitude brightening of seismic reflections from subsurface zones affected by local heating. These two phenomena have been confirmed by synthetic modelling and form the basis of the seismic thermal monitoring technique. In addition, work in progress at the Gregoire Lake In-Situ Steam Pilot site in Alberta has shown that excellent seismic resolution can be obtained through careful field planning and acquisition. Such resolution may enable the determination not only of the horizontal extent of the thermal flood, but also of the vertical distribution, through techniques such as seismic inversion and pushdown analysis. By comparing a pre- and post-steam seismic response, changes due to heating can be isolated and interpreted. If these responses are inverted as well, they may be subtracted to permit direct interpretation of the effects of heating. Such difference analysis may prove to be the most powerful means of studying thermal flood behavior. 6 refs., 15 figs.

41621 (AOSTRA–8808, pp. 10) **Ground geophysical surveys, Daphne Leases, Athabasca, Alberta.** Isherwood, A.E. (Petro-Canada, Inc., Canada); Henderson, J.D. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, 7-12 Aug 1988; CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In 1986, Petro-Canada carried out an extensive exploration effort of the Daphne leases 65 km north of Fort McMurray, Alberta. This included surveys using four geophysical techniques. The geological settings of the deposits are described. The electric geophysical methods used were resistivity and electromagnetic induction (for shallow depths); the seismic geophysical methods are refraction seismic and reflection seismic. Data acquisition and processing are described. In 1985, seven continuously cored holes were drilled along a line perpendicular to the Athabasca River. Information from three of these holes was used to calibrate the equipment interpretation; the other four holes were used as controls. In general, the lithological contacts predicted by the geophysical work compare relatively favorably with the drill hole data. It appears that the electrical methods are particularly effective when rich oil sand is near the surface. The refraction/electrical combination is a useful exploration tool, but of more limited usefulness once the broader exploration work is complete. Additional work is required to answer questions

regarding the structure and associated hydrological conditions within the Devonian formations. The limited high resolution reflection data showed several interesting features. 3 refs., 6 figs., 2 tabs.

0402 Site Geology and Hydrology

Refer also to citation(s) 41621

0403 Drilling, Fracturing, and Mining

41622 (MC/C–8609) **The assessment, evaluation and validation of a computer based simulation model. Final report.** Monenco Consultants Ltd., Calgary, AB (Canada). 1986. 154p. (MICROLOG–87-02230). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

The object of this report is to assess, evaluate and validate a computer-based simulation model of a bucket wheel excavator (BWE)-conveyor-bin/hopper mining system. The evaluation was to address a critical appraisal of the software documentation, and observations made while preparing the data and operating the simulator. It is seen that the simulator modules were built with the goal of simulating the operations of the equipment sufficiently well for use in production monitoring. The required accuracy is achieved by modelling the equipment functions at their most detailed level, based on proven empirical formulae. It is doubtful whether this precision is required when the equipment is used in a full operational environment. Cumulatively, the importance of arbitrary operational factors on overall productivity is at least as great as the precise empirical calculations. Because of these uncertainties, a much simpler excavator model that employed distributions for the various operation times would provide a result equally reliable to the current method, but with far less computational effort. The overall impression of the documentation with respect to understanding the theory is very favourable. The modules are less successful at helping with data entry and running the program. Serious deficiencies are apparent in data file formats and there are no user help sections. The simulator is difficult to get to work and cannot handle a relatively simple test case. A number of changes are suggested to make the simulator more useful for overburden mining. These changes amount to a virtual re-writing of the entire excavator module, plus significant changes to the conveyor module. 11 figs 22 tabs

0404 Oil Production, Recovery, and Refining

Refer also to citation(s) 41416, 41417, 41418, 41546, 41632, 41633

41623 (AOSTRA–8808, pp. 8) **Front surveillance and contol in a steamflood project.** McGee, J. (Petroleos de Venezuela, Caracas, Venezuela); Yibirin, J.; Solano, E. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, 7-12 Aug 1988; CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper presents a description of two steam front tracking techniques, the combination of formation density, compensated neutron, gamma ray, and high resolution logs in observation wells and three different radioactive tracers. These are complemented by the analysis of water cut and salinity. After the principles behind each technique have been discussed, results from the application of these techniques in the Jobo Steamflood Project, in eastern Venezuela, are presented and analyzed in detail. The main benefits have been an accurate determination of the steamfront geometry, which in turn allowed remedial actions to force the front toward unswept zones, and estimates of areal and vertical conformance factors. 4 refs., 2 figs., 3 tabs.

41624 (AOSTRA–8808, pp. 18) **Geochemical monitoring of oil field fluids.** Gunter, W.D (Alberta Research Council, Edmonton, AB, Canada); Perkins, E.H.; Young, B.; Bird, G.W. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, 7-12 Aug 1988; CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The produced water chemistry of oil sand reflects its source and the path it followed through the reservoir on its way to the production well. It can be used to help decipher formation damage in the reservoir and reservoir sweep. The water is modified by mixing of injection and connate waters, boiling, and water-mineral reactions. Careful sampling and chemical analysis of the produced and connate water are necessary to be able to interpret the produced water chemistry quantitatively. Sampling technique is important. Either quench, isobaric, or isobaric-isothermal samples of produced water are taken at the wellhead. Connate water has to be extracted from preserved drill core because of the very low hydraulic conductivity of the oil sand. The produced water chemistry from cyclic steaming of the oil sands of Alberta is used to calculate reservoir temperatures from the SiC\sub 2/and Na/K geothermometers. These reservoir temperatures and the water chemistry are combined on mineral stability diagrams to predict clay minerals being destroyed and synthesized in the reservoir during steaming. Kaolinite is destroyed while illite, smectite, zeolites, and chlorite are being synthesized. Reservoir sweep is monitored from one cycle to another by correlating cumulative oil production, cumulative water production, and chloride ion content of the produced water for each well. For the wells examined, the relative mobility is constant over the latter part of each cycle unless breakthrough occurs. 23 refs., 10 figs.

41625 (AOSTRA–8808, pp. 12) **Interpreting reservoir performance using produced water chemistry.** Russell, B. (AEC Oil and Gas Co., Calgary, AB, Canada); Bird, G.W. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, 7-12 Aug 1988; CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In cyclic steam operations, the produced water chemistry changes as a cycle matures and between cycles. A technique has been developed to use water chemistry data to calculate the ratio of formation water to steam condensate in the produced water. When this technique is combined with geothermometry, the reservoir engineer can identify whether steam is contacting new oil, a previously steamed portion of the reservoir, non-productive formations, or thief zones. This paper demonstrates the theoretical foundation of this new technique and provides case histories from a cyclic steam stimulation pilot project in the Primrose area of Alberta. Its use as a diagnostic tool in measuring the efficiency of individual cycles and understanding the heating and process mechanisms is explained. Examples of how the tool is used in evaluating and optimizing operating strategies or assessing the effectiveness of remedial workovers are also described. 4 refs., 11 figs., 1 tab.

41626 (AOSTRA–8808, pp. 14) **Thermal hydroprocessing of Syncrude coker gas oil. Interpretation via structural group analysis.** Nizinska-Bazaniak, B. (Univ. of Alberta, Edmonton, AB, Canada); Gray, M.R.; Rangwala, H.; Khorasheh, F.; Wanke, S.E.; Della Lana, G. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, 7-12 Aug 1988; CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Structural group analysis (SGA) of heavy gas oils provides a quantitative approach to the chemical characterization of such feedstocks and their upgraded products. SGA combines various analytical data obtained by class separation, elemental analysis, ^{1}H-NMR, ^{13}C-NMR, IR, and other special techniques to define concentrations of groups such as aromatics, naphthenes, paraffins, and heteroatom structures. Thermal hydroprocessing of Syncrude coker gas oil (SCGO) was studied as a preliminary to the detailed evaluation of catalytic hydroprocessing. SCGO is the major synthetic feedstock currently being produced in Canada. The processing was performed in a continous stirred-tank reactor at 13.9 megapascals pressure (mainly H_2) and temperatures from 360 to 450^{0}C. Comparisons between feed and product liquid structural profiles show that, from 360 to 400^{0}C, thermal hydroprocessing predominantly cracked long aliphatic chains and opened naphthenic ring structures, but without significantly affecting the amounts of aromatic and naphthenic carbon present. More extreme heating (above 400^{0}C) further destructs naphthenic structures, which fragments are then hydrogenated to paraffins or dehydrogenated to aromatics, depending upon the amount of dissolved hydrogen available for reaction. Because the temperature dependency of cracking rapidly changes the cracking rate with increasing temperature, cracking dominates and, beyond 450^{0}C, coke formation becomes substantial. These general trends were discussed in terms of structural group profiles. 21 refs., 1 fig., 9 tabs.

41627 (AOSTRA–8808, pp. 13) **Conversion of tar sand bitumen and heavy crude to high yields of aviation turbine fuel.** Talbot, A.F. (Sun Refining and Marketing Co.); Hook, M; Harrison, W.E. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, 7-12 Aug 1988; CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The production of specification quality military aviation turbine fuel from low grade domestic fossil energy resources is of interest to the United States Air Force. This paper describes a U.S. Air Force sponsored study of the conversion of tar sands bitumens and heavy crudes into high yields of specification quality JP-4 and JP-8 aviation turbine type fuels. Primary upgrading of residuum fractions was via high severity hydrovisbreaking. Downstream refining included naphtha hydrotreating and distillate hydrocracking. Both bench-scale and pilot plant studies contributed to the development of a plant design and process economics for a 50,000 barrels per stream day refinery. Process simulations predicted nearly 90 vol% yield of JP-4 type, or 50 vol% yield of JP-8 type fuel, with less than 2 vol% net production of residual fuel. Capital investment for this technology appears to be high, compared to approaches that use less extensive hydroprocessing and produce a wider mix of transportation fuels. In upgrading residua by high conversion hydrovisbreaking, net residual fuel production can be very low, while the process appears relatively insensitive to feedstock. Opportunities for cost reduction arose during this study. The conversion of feed-bound nitrogen is one key to reducing costs. 7 refs., 4 figs., 12 tabs.

0405 Properties and Composition

Refer also to citation(s) 41581, 41619, 41620, 41624, 41625, 41626, 41627, 43259

41628 (AOSTRA–8808, pp. 25) **Improved core testing to aid heavy oil field development.** Black, C.J.J. (British Petroleum PLC, Middlesex, England); Henning, P.J.; Sincock, K.J. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, 7-12 Aug 1988; CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Many factors influence fluid and core data and, these data are often used to forecast reservoir behavior. Careful sample acquistion, preparation, and test design are required to obtain data representative of the reservoir. Recommended methods, and the rationale underlying them, are presented, with emphasis on the following: effects of time and temperature on oil viscosities measured on oil extracted from core samples; detection and minimization of unconsolidated core sample damage; restoration of core samples in terms of overburden stress, wettability, and fluid saturation history; effects of high speed centrifugation on sample morphology and fluid distribution; and oil recovery test design to account for the influence of flow rate, sample end effects, adverse viscosity ratio, and high temperature effects. Heavy oil reservoirs provide many challenges to core testing technology, however, by acknowledging the special features of heavy oil reservoirs and by taking advantage of modern core testing procedures, reliable data for input to field development studies can be produced. 32 refs., 16 figs., 1 tab.

41629 (AOSTRA–8808, pp. 16) **Organic deposition from heavy petroleum crudes (a fractural aggregation theory approach).** Park, S.J. (Univ. of Illinois, Chicago, IL, USA); Mansoori, G.A. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, 7-12 Aug 1988; CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Deposition of complex and heavy organic compounds that exist in heavy petroleum crude can cause a number of severe problems. To prevent deposition inside the reservoir, in the well head, and inside the transmission lines, it is necessary to be able to predict the onset and amount of deposition due to various factors. In this paper the mechanisms of organic deposition are modelled on the basis of different theories, continuous thermodynamic (CT) model and steric colloidal (SC) model, and their predictive capabilities are discussed. The chromatographic characterization of organic deposits from different crude oils is also presented. The kinetic theory of aggregation allows the development of a fractal aggregation (FA) model that combines the ideas of the two proposed CT and SC models. The FA model is capable of describing several situations, such as the phenomena of organic deposition, the growing mechanism of heavy organic aggregates, the geometrical aspects of aggregates, the size distributions of precipitated organics, and the solubility of heavy organics in a heavy oil under the influence of miscible solvents. 40 refs., 6 figs., 5 tabs.

41630 (AOSTRA–8808, pp. 3) **Working group on laboratory standards for characterizing heavy crudes and tar sands programme objectives.** Barsk-Rundguist,E. (UITAR/UNDA Info. Centre for Heavy Crude and Tar Sands, NY, USA INTENEP, S.A., Apartado, Caracas, Venezuela); Buenafama, H.D.; Betancourt, J. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, 7-12 Aug 1988; CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

To date, heavy and extra heavy crude characterization has been performed by using methods, techniques, and equipment originally designed for light and medium crudes. However, no evaluation has been made on the validity of such procedures when they are applied to heavy crudes, and there are no reference standards to assess the performance and quality of the results of individual laboratories. At present, the UNITAR/UNDP Information Centre for Heavy Crude and Tar Sands sponsors an international program to establish laboratory standards for characterizing heavy crudes and residues. This program, defined and approved in September 1987

by 18 petroleum companies from different countries, envisages three main activities and objectives: evaluation of analytical methods and techniques for heavy crude and tar sands bitumen characterization and laboratory performance; analysis and interpretation of results; and proposals of modifications of analytical procedures to improve the reliability of the results. 1 tab.

41631 (AOSTRA–8808, pp. 14) **Bemolanga bitumen and Tsimiroro heavy oil study.** Ravelosen, E.A. (Office Militaire National pour les Industries Strategiques (OMNIS), Antananarivo, Madagascar); Rouviere, F.; Ruiz, J.M.; Lena, L. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, 7-12 Aug 1988; CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper deals with a study of various heavy hydrocarbons samples from Madagascar. The first part concerns the chemical analysis of Bemolanga bitumen and Tsimiroro heavy oil and the separation of hydrocarbons into saturated hydrocarbons, aromatics, polar compounds, and asphaltenes. Different analytical methods were used, according to the specificity of each class of hydrocarbons (liquid chromatography, gas chromatography, gel permeation chromatography, proton nuclear magnetic resonance). Modelling was also used. The naphthenic cycles of saturated hydrocarbons were obtained through palladium-catalytic dehydrogenation. The second part concerns the study of porphyrins. The identification of porphyrins was mainly realized by visible absorption and Fourier transform infrared spectroscopy. Porphyrins were concentrated by liquid-liquid extraction, using acetonitrile. Nickel-porphyrins have been identified and vanadium-porphyrins have been detected. Given the low vanadium content of the initial samples (18 ppM), nickel-porphyrins can be used as geochemical markers for petroleum exploration in Madagascar. 30 refs., 7 figs., 13 tabs.

41632 (AOSTRA–8808, pp. 8) **Diesel and jet fuel production from Athabasca bitumen, and cetane number correlation.** Yui, S.M. (Syncrude Ltd., Edmonton, AB, Canada); Sanford, E.C. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, 7-12 Aug 1988; CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Hydrotreating experiments were conducted in a pilot-scale reactor over commercial $NiMo/Al_2O_3$ catalysts, varying the temperature (320-372^{0}C), pressure (6-11 megapascals), and liquid hourly space velocity (0.7-1.5 h^{-1}). Feeds were light gas oil fractions from virgin, coked, and hydrocracked Athabasca bitumen. Feeds and products were further distilled into diesel and jet fuel cuts, and the cetane number, smoke point, and other major product specification items were determined. Under the conditions tested, the maximum improvement in cetane number over that of feeds was about 7 and smoke point increased by only a maximum of 3 mm. To produce on-spec diesel and jet fuels, more severe operating conditions are needed. These could include higher pressure, lower space velocity, or specially designed catalysts. Raising reactor temperature is not an acceptable strategy because the extent of aromatics hydrogenation is limited be thermodynamic equilibrium. The American Society for Testing Materials cetane index is not applicable to synthetic fuels derived from oil sand bitumen. This paper presents a new correlation, incorporating density, mid-boiling point, and aniline point. This shows improved fit using a wide range of synthetic distillates from virgin, coked, and hydrocracked bitumen. 11 refs., 1 fig., 5 tabs.

41633 (TDGC–89-5) **Evaluation of New Brunswick shale oil for its potential as an asphalt feedstock.** Ball, F.D. Three-D Geoconsultants Ltd., Fredericton, NB (Canada). 1989. 95p. (MICROLOG–89-02485). Available from New Brunswick Dept. of Natural Resources and Energy, P.O. Box 6000, Fredericton, NB, CAN E3B 5H1; $4.65 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In the United States, sectors of the oil shale industry have recognized the market potential for shale oils in asphalt production. Research suggests that shale-oil-based asphalts enhance pavement durability. Evidence indicates that basic, probably pyridinic, nitrogen compounds are responsible for the observed increased moisture resistance of shale-oil-derived asphaltic concretes. In addition, it has been found that nitrogen-bearing additives derived from both shale oil and coal liquids enhance pavement flexibility and durability upon recycling. Western U.S. shale oil asphalts, however, are susceptible to oxidative hardening, a feature detrimental to pavement durability. Blends of petroleum asphalts and up to 20% shale oil asphalt show no abnormal susceptibility to oxidative hardening but do exhibit improved resistance to moisture damage. Shale oils derived from the Albert Formation in New Brunswick are nitrogen-bearing, but no information exists indicating their content of the various types of nitrogen compounds. The use of New Brunswick shale oil as a feedstock for the production of asphalt to be blended with conventional petroleum asphalts or for the production of asphalt recycling agents is worthy of further consideration. Such products would not compete directly with conventional oil and gas as a fuel and could command, due to enhanced performance, a market advantage in preference to competing conventional crude-derived asphalt products. Production of such products would therefore buffer the economics of producing shale oil against the full brunt of the downside to conventional crude oil markets. To this end, a program of further work is recommended. 13 refs., 24 tabs.

0408 Marketing and Economics

Refer also to citation(s) 41627, 41633

0409 Waste Research and Management

Refer also to citation(s) 41561

0410 Environmental Aspects

41634 (CU/KC–88-3) **Revegetation of oil sands tailings. Growth improvement of silver-berry and buffalo-berry by inoculation with mycorrhizal fungi and N_2-fixing bacteria.** Visser, S.; Danielson, R.M. Calgary Univ., AB (Canada). Kananaskis Centre for Environmental Research. 1988. 130p. (MICROLOG–89-02222). Available from Alberta Legislative Library, 216 Legislature Bldg., Edmonton, AB, CAN T5K 2B6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The ability of actinorhizal shrubs to tolerate inhospitable conditions while improving soil fertility and organic matter status has led to increased usage of these plants for land reclamation and amenity planting purposes. Silver-berry and buffalo-berry are two such shrubs being tested as potential candidates for the revegetation of the oil sands tailings in northeastern Alberta. Associated with the roots of silver-berry and buffalo-berry are two symbiants, the N_2-fixing actimomycete Frankia and the vesicular-arbuscular mycorrhizal (VAM) fungi. Numerous studies have demonstrated that, particularly in nutrient-limited conditions, mycorrhization and nodulation can result in significantly better plant performance as a consequence of improved N and P nutrition. It was found in this study that in Alberta, silver-berry and buffalo-berry are strictly VA mycorrhizal; that they are highly dependent on their symbiants for optimum growth; and that the VAM inoculum potential of both stockpiled and undisturbed muskeg peak is negligible, due to the absence of VAM hosts. Means to increase the inoculum potential of peat have been studied. The efficacy of inoculating seedlings grown in greenhouses with VAM and Frankia has been demonstrated. Overwinter mortality was higher for inoculated shrubs, but after one growing season, shoot-weights of silver-berry were 3 to 7 times greater than for uninoculated shrubs, and shoot weights of buffalo-berry were 3 to 5 times greater. 122 refs., 12 figs., 31 tabs.

41635 (CU/KC–88-5) **Ectomycorrhizae of jack pine and green alder. Assessment of the need for inoculation, development of inoculation techniques, and outplanting trials on oil sand tailings.** Danielson, R.M.; Visser, S. Calgary Univ., AB (Canada). Kananaskis Centre for Environmental Research. 1988. 177p. (MICROLOG–89-02225). Available from Alberta Legislative Library, 216 Legislature Bldg., Edmonton, AB, CAN T5K 2B6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The overall objective of these studies was to characterize the mycorrhizal status of jack pine and green alder, which are prime candidates as reclamation species for oil sand tailings, and to determine the potential benefits of mycorrhizae on plant performance. This entailed determining the symbiont status of container-grown nursery stock and the quantity and quality of inoculum in reconstructed soils, developing inoculation techniques, and finally, performance testing in an actual reclamation setting. Much emphasis has been placed on gaining information on the fungi involved in the symbioses, as little is known about the ecology of mycorrhizal fungi and this information is essential for successfully applying the technology. It appeared that multi- and late-stage fungi are more sensitive to certain biological soil factors than early-stage fungi. 168 refs., 1 fig., 64 tabs.

05 NUCLEAR FUELS

0501 Reserves, Exploration, and Mining

Refer also to citation(s) 41758, 42695

41636 (CANMET-R–85-4E) **RL-1: a certified uranium reference ore.** Steger, H.F.; Bowman, W.S. Canada Centre for Mineral and Energy Technology, Ottawa, ON (Canada). Mining Research Labs. Jun 1985. 20p. Order Number DE89635107/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A 145-kg sample of a uranium ore from Rabbit Lake, Saskatchewan, has been prepared as a compositional reference material. RL-1 was ground to minus 74 μm and mixed in one lot. Approximately one half of this ore was bottled in 100-g units, the remainder being stored in bulk. The homogeneity of RL-1 with respect to uranium and nickel was confirmed by neutron activation and X-ray fluorescence analytical techniques. In a 'free choice' analytical program, 13 laboratories contributed results for one or more of uranium, nickel and arsenic in one bottle of RL-1. Based on a statistical analysis of the data, the following recommended values were assigned: U, 0.201%; Ni, 185 μg/g; and As, 19.6 μg/g.

41637 (INIS-mf–11510) **Uranium occurrences of the Thunder Bay-Nipigon-Marathon area.** Scott, J.F. Ontario Geological Survey, Toronto, ON (Canada). 1987. 172p. Order Number DE89635108/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Ontario Geological Survey open file report 5634. Map in back pocket.

During the 1981, 1982 and 1983 field seasons an inventory of all known uranium occurrences in the North Central Region of Ontario was undertaken. Three major categories of uranium occurrences were identified: uranium associated with the rocks of the Quetico Subprovince; uranium associated with the Proterozoic/Archean unconformity; and uranium associated with alkalic and carbonatite rocks of Late Precambrian age. Occurrences associated with the Quetico Belt are in white, albite-quartz-muscovite pegmatites. Occurrences associated with the Proterozoic/Archean unconformity are usually of high gradee (up to 12% U_3O_8), nearly always hematized and are related to fault or shear zones proximal to the unconformity. Although of high grade, many of the unconformity related occurrences are very narrow (<1 m). Alkalic and carbonatite rocks of Late Precambrian age are an important source of uranium but possible metallurgical problems might downgrade their potential. The Quetico Subprovince is anomalously high in background uranium, and therefore contains important source rocks for uranium. Areas that have the highest potential for uranium deposits in the North Central Region are the Nipigon Basin area, and the areas underlain by the Gunflint and Rove Formations. All the high grade vein-type uranium deposits related to the unconformity are found within the Nipigon Basin. 126 refs.

0504 Feed Processing

Refer also to citation(s) 41768

41638 (MRP/MSL–85-57(TR)) **Jarosite formation in the uranium processing circuit of Denison Mines Limited, Elliot Lake, Ontario.** Dutrizac, J.E. Canada Centre for Mineral and Energy Technology, Ottawa, ON (Canada). Mining Research Labs. Apr 1985. 21p. Order Number DE89634921/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Jarosite precipitation occurs in several parts of the uranium processing circuit of Denison Mines Limited, Elliot Lake, Ontario. Extensive precipitation of jarosite takes place in the filter cloth and on the drum face of the secondary drum filters, and this precipitation causes severe operating difficulties. Precipitation of jarosite is also observed in the ion exchange beads, but it is not known whether the jarosite is responsible for the observed decrease in resin efficiency. The resin beads are also rimmed with significant quantities of silica, lead, phosphate, sulphate, etc. which could be responsible for the fouling of the resin. In every instance, potassium jarosite, containing only minor amounts of sodium or ammonium, was the observed species; the potassium likely originates from the acid leaching of muscovite in the ore. Potential methods of avoiding the jarosite problem are discussed, but these may not be compatible with the overall process requirements.

0505 Uranium Enrichment

Refer also to citation(s) 44326

41639 (K/QT–295) **Hydraulic and thermal analysis of liquid UF_6 transfer.** Blankenship, J.G.; Park, S.H. Oak Ridge Gaseous Diffusion Plant, TN (USA). Quality and Technical Services Div. Jun 1989. 20p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OT21400. Order Number DE89016156/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The need for additional autoclaves at the Portsmouth Gaseous Diffusion Plant has prompted an examination of the process of transferring liquid UF_6 from cylinder to cylinder. An issue which has been raised is the need for an elevation difference between parent and daughter cylinders to induce a sufficient liquid UF_6 flow rate. It has been proposed that cooling effects are sufficient to cause the vapor pressure in the receiving cylinder to be sufficiently lower than the pressure in the parent cylinder in the autoclave to provide the driving force needed for flow. Discussions between three-site technical personnel indicate that the thermodynamics of the cylinder filling process, which control the cylinder pressure, are not clearly understood. Furthermore, the hydraulics of the transfer flow indicate that higher liquid flow rates should be attained than are experienced in practice. In order to more clearly understand these issues and to explore the possibility of improvements, an experimental and analytical study was undertaken. 3 refs., 10 figs., 1 tab.

0507 Fuels Production and Properties

Refer also to citation(s) 41775, 41986, 42505, 42652, 42653, 42654, 42659, 42663, 42684, 44021, 44029

0508 Spent Fuels Reprocessing

Refer also to citation(s) 41759, 41774, 41970, 42629, 42636, 42643, 42644, 42854, 42911, 43200

41640 (INIS-mf–11989, pp. 223) **The use of neptunium-239 to assess neptunium distribution throughout a nuclear fuel reprocessing plant.** Mair, M.A. (UKAEA Dounreay Nuclear Power Development Establishment, Thurso (UK)); Savage, D.J.; Prentice, P.C. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference*

on analytical chemistry in nuclear technology. Abstracts. Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41641 (INIS-mf–11989, pp. 223) **Surface analytical characterization of undissolved residuals of the nuclear fuel reprocessing.** Pfennig, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie); Klewe-Nebenius, H.; Bruns, M.; Wertenbach, H.; Ache, H.J. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

41642 (INIS-mf–11989, pp. 223) **Multiement analysis of radioactive reprocessing solutions with the help of TRFA.** Eggers, I. (Hamburg Univ. (Germany, F.R.). Inst. fuer Anorganische und Angewandte Chemie); Haarich, M.; Knoechel, A.; Salow, H. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41643 (INIS-mf–11989, pp. 223) **On-line measurement of off-gaz iodine level in the dissolution unit of a reprocessing plant.** Pradet, B. (CEA Centre de Marcoule, 30 - Bagnols-sur-Ceze (France)); Roche, C.; Remy, B. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41644 (INIS-mf–11989, pp. 223) **The use of a double tracer addition technique in the calibration of tank volumes.** Reed, W.J. (British Nuclear Fuels Ltd., Sellafield); James, M.R.; Taylor, G.E. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41645 (INIS-mf–11989, pp. 223) **The application of isotope dilution mass spectrometry to the analysis of highly active liquors.** Reed, W.J. (British Nuclear Fuels Ltd., Sellafield); Taylor, G.E.; James, M.R. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41646 (INIS-mf–11989, pp. 223) **Ammonium in the purex process.** Horn, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie); Lang, S.; Scherwitzl, J.; Ertel, D. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41647 (INIS-mf–11989, pp. 223) **Influence of several components of MAW on the luminescence of uranyl-ions in nitric solution.** Hoeppener-Krammar, U. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie); Mainka, E. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41648 (INIS-mf–11989, pp. 223) **Photoacoustic determination of neptunium in nuclear reprocessing raffinates.** Stahr, B. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie); Faubel, W.; Menzler, P.M.; Ache, H.J. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41649 (INIS-mf–11989, pp. 223) **Chemical and radiochemical composition analyses of high level liquid waste.** Yun Jinli (Institute of Atomic Energy, Beijing, BJ (China)). Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41650 (INIS-mf–11989, pp. 223) **ICP measurement of ^{235}U content in reprocessing plant input solutions.** Sourrouille, M. (Compagnie Generale des Matieres Nucleaires (COGEMA), Centre de Marcoule, 30 - Bagnols-sur-Ceze (France)); Andrieu, G.; Aubanel, R.; Doutreluingne, P.; Schott, R. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41651 (INIS-mf–11989, pp. 223) **The performance of the quality control in the analytical laboratory of WAK.** Stojanik, B. (Wiederaufbereitungsanlage Karlsruhe Betriebsgesellschaft m.b.H. (WAK), Eggenstein-Leopoldshafen (Germany, F.R.)); Steinkuhle, P. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41652 (INIS-mf–11989, pp. 223) **On-line fibre-optic spectrophotometry in a plutonium pulsed column pilot plant.** Mackay, C.N.N. (UKAEA Dounreay Nuclear Power Development Establishment, Thurso (UK)); Mills, C.L.; Kyffin, T.W. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41653 (INIS-mf–11989, pp. 223) **In line and real time assay of uranium, plutonium and other heavy elements in process solutions.** Guiberteau, P. (CEA Centre d'Etudes de Valduc, 21 - Is-sur-Tille (France)); Gontier, J.; Pelletier, T.; Bergey, C. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41654 (INIS-mf–11989, pp. 223) **A microcomputer controlled hot-cell titration system.** Klatt, L.N. (Oak Ridge National Lab., TN (USA)). Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. DOE Contract AC05-84OR21400. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41655 (INIS-mf–11989, pp. 223) **An XRF analyzer for the on-line monitoring of uranium.** Ottmar, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik); Michel-Piper, I. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

41656 (INIS-mf–11989, pp. 223) **A fiber-optic probe for laser photometric measurements in liquid dispersions.** Schmidt, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente); Eggert, E.; Tsouris, C.; Taviarides, L.L. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41657 (INIS-mf–11989, pp. 223) **Applications of fiber-optic spectrophotometry at the Savannah River Plant.** Van Hare, D.R. (Savannah River Plant, Aiken, SC (USA)); O'Rourke, P.E.; Prather, W.S. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

41658 (INIS-mf–11989, pp. 223) **The application of X-ray absorption edge densitometry to the non-destructive determination of element concentrations and coating thicknesses.** Taylor, B.L. (UKAEA Harwell Lab. (UK)); Wilkins, C.G. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41659 (INIS-mf–11989, pp. 223) **Fiber optic modification of the process photometer SPECTRAN for in-line measurements in nuclear fuel reprocessing.** Buerck, J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie); Kraemer, K.; Koenig, W. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41660 (INIS-mf–11989, pp. 223) **^{31}P NMR spectroscopy as an analytical and an investigation tool in the PUREX process.** Vitart, X. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)); Musikas, C.; Livet, J.; Morisseau, J.C.; Vilarem, J.P. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41661 (INIS-mf–11989, pp. 223) **Gas chromatography Fourier transform infrared (G.C.-FTIR): Application to the determination of degradation products of TBP solutions.** Ginisty, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)); Charbonnel, M.C.; Cames, B. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

41662 (INIS-mf–11989, pp. 223) **The determination of azide in nuclear fuel reprocessing streams using ion chromatography.** Knight, M. (British Nuclear Fuels Ltd., Sellafield). Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41663 (INIS-mf–11989, pp. 223) **Development of the analytical method of alkyl iodines in the normal dodecane separated from PUREX waste solvent.** Ichikawa, Goro (Sumitomo Metal Mining Co. Ltd., Tokai, Ibaraki (Japan)); Aruga, Ayako; Tanaka, Chuzaburo; Nakahira, Hiroshi; Ozeki, Noboru. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

41664 (INIS-mf–11989, pp. 223) **Identification and quantification of volatile organoiodine compounds in the PUREX process.** Stieglitz, L. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)); Bautz, H.; Schoor, A. van; Herrmann, F.J. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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41665 (INIS-mf–11989, pp. 223) **An optimised automatic sampling system for radioactive and toxic liquids.** Berg, R. (Wiederaufbereitungsanlage Karlsruhe Betriebsgesellschaft

m.b.H. (WAK), Eggenstein-Leopoldshafen (Germany, F.R.)); Schaarschmidt, U. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

41666 (INIS-mf–11989, pp. 223) **Separation of technetium, palladium and ruthenium from nitric acidic process solutions.** Ghafourian, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie); Sameh, A.A.; Ache, H.J. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

41667 (INIS-SU–97, pp. 31-36) **Tri-n-butyl phosphate - the universal solvent for the nuclear fuel cycle.** Naylor, A. (British Nuclear Fuels Ltd., Springfields (UK)); Eccles, H. AN SSSR, Moscow (USSR). 1988. (CONF-8807136–: ISEC '88: international solvent extraction conference, Moscow (USSR), 18-24 Jul 1988). In *International solvent extraction conference. Vol. 1. Conference papers.* Order Number DE89012151/JAW. Available from NTIS (US Sales Only), PC A1/MF A01; INIS.

Tri-n-butyl phosphates (TBP) is now Widely used in the processes of solvent extraction, especially in those, used in nuclear fuel cycle. Problems, related with actinide separation and purification, can be solved easily by accurate sampling of diluent, concentration and purification degree of a solvent, aqueous phase acidity and temperature. Physical and chemical properties of TBP, mechanism of actinide solvent extraction, TBP hydrolysis and radiolysis are considered. 1 tab.

41668 (INIS-SU–97, pp. 291-296) **Malonamides as new extraction.** Cuillerdier, C.; Hubert, H.; Hoel, P.; Musikas, C. AN SSSR, Moscow (USSR). 1988. (CONF-8807136–: ISEC '88: international solvent extraction conference, Moscow (USSR), 18-24 Jul 1988). In *International solvent extraction conference. Vol. 1. Conference papers.* Order Number DE89012151/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Possibility of using malonic acid diamides as extractants in the processes of nuclear fuel reprocessing is considered. Mechanisms of americium and europium extraction from $HClO_4$ and HNO_3 aqueous solutions by dimethyldioctylmalonamide in t-butylbenzene studied. Distribution coefficients of Am(3), Eu(3), Pu(4), U(6), Zr(4), Tc(7) in extraction with substituted diamides were determined. The results obtained show that studied extractions were of interest for extracting α-emitters from wastes of nitric acid solutions. However it is necessary first to study their radiolytical stability and develop economical methods of synthesis. 3 refs.; 5 figs.; 4 tabs.

41669 (KFK–4476) **Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.** Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. 463p. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

The report contains all lectures on the present state of the R+D work which were delivered on the occasion of the 7th seminar on the present state of the Reprocessing and Waste Treatment Project in the Karlsruhe Nuclear Research Centre on 15/16 March 1988. The project is aimed at improving methods for nuclear waste disposal with regard to the German reprocessing plant for light-water reactor fuels currently under construction in Wackersdorf. The individual contributions were separately adapted for the INIS and EDB data banks. (RB).

41670 (KFK–4476, pp. 5-12) **Status report on the work done in the context of the Reprocessing and Waste Treatment Project.** Kroebel, R. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

Of the research work by the Karlsruhe Nuclear Research Centre accompanying the planning and construction phase of the Wackersdorf Reprocessing Plant/FRG, the contribution discusses the work on improving the safety of the plant, such as the further developed iodine retention technology and the PAMELA vitrification method for HAW, which has been actively demonstrated by now. Progress in the trial of test plants and other subject areas are briefly outlined and development targets in the project are pointed out. (RB).

41671 (KFK–4476, pp. 13-32) **Present reprocessing situation in France.** Lallement, R. (CEA, 75 - Paris (France). Direction des Technologies); Chaudat, J.P. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

The author describes the role of nuclear fuel reprocessing in the French nuclear energy programme and gives an outline of its historical development up to industrialization. The transition from gas-graphite fuel to LWR fuel was achieved without any significant modification of the Purex process in the existing and finally enlarged plants at Marcoule and La Hague. The capacity of the plants achieved by the end of the year 1987 is illustrated by data. Breeding fuels with a high burn-up have been reprocessed in pilot plants of La Hague since 1969 and in Marcoule since 1975. The current R+D programme to improve the components and waste treatment methods is briefly outlined. (RB).

41672 (KFK–4476, pp. 51-54) **Status report on planning and construction of the Wackersdorf reprocessing plant.** Mattern, J. (Siemens A.G. Unternehmensbereich KWU, Offenbach am Main (Germany, F.R.)). Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

The present state of the planning and construction work and of the licensing procedure for the construction of the German reprocessing plant at Wackersdorf is briefly illustrated. The contribution reports necessary modifications of the 1984 concept. (RB).

41673 (KFK–4476, pp. 55-68) **Status and goals of development of nuclear fuel reprocessing.** Ebert, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

Research work at Karlsruhe Nuclear Research Centre (KfK) for optimization of the Purex process is aimed at designing the necessary operations for uranium-plutonium separation in the 1st extraction cycle so efficiently that the remote purification of product streams with a simple process, i.e. crystallization, can be achieved.

Specific difficulties as regards the realization of this aim together with the progress achieved are briefly described. In addition the process model VISCO is given special importance. Further development work, e.g. process engineering of waste gas treatment, and the situation of staff and training in relation to the promotion by the Federal Government are also discussed. (RB).

41674 (KFK–4476, pp. 85-104) **IRCH developments and test benches relevant to reprocessing and waste treatment.** Ache, H.J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie). Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

In the last two years the work at the Institute for Radiochemistry has strongly developed from process engineering and process chemistry towards process analytics and analytics in general. The article reports on studies from the field of special analytics on waste characterization - separation of Pu from cement samples, isotope composition of U and Pu in waste concentrates - and on the characterization of dissolution residues from reprocessing. From the most recent developments in the field of analytic techniques an arrangement for pulsed photoacoustic spectroscopy for the measurement of excited Pu and Np-species during their transition to the ground state is described. For the testing of new in-line methods for process control hot analytic test benches were developed which also offer the possibility of testing new concepts of waste minimization. Other radiochemical-experimental developments are briefly mentioned. (RB).

41675 (KFK–4476, pp. 105-114) **Development activities under industrial conditions - elements for plant operation and projecting.** Huppert, K.L. (Wiederaufbereitungsanlage Karlsruhe Betriebsgesellschaft m.b.H. (WAK), Eggenstein-Leopoldshafen (Germany, F.R.)); Eiben, K.; Kuhn, K.D.; Issel, W. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

A report is given on the development activities of the DWK (German Society for Reprocessing of Nuclear Fuels) and their holding companies, especially the WAK (Karlsruhe Reprocessing Plant) in the field of nuclear waste disposal. This includes improvements of the reprocessing process, iodine separation from the container waste gas, separation of disturbing elements, compounds and radiolysis products from the process, remote-controlled maintenance (FEMO technology), extraction components, monitors, hydraulic of fuel solutions. (RB).

41676 (KFK–4476, pp. 115-143) **New performance data of the WAK.** Willax, H.O. (Wiederaufbereitungsanlage Karlsruhe Betriebsgesellschaft m.b.H. (WAK), Eggenstein-Leopoldshafen (Germany, F.R.)); Weishaupt, M.; Stojanik, B.; Huebner, H. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

Results of the trial operation of the WAK are presented. Details are given of the reprocessing and intervention programme: (a) reprocessing of mixed oxide fuels (MOX) from the nuclear power plant Obrigheim, (b) the putting into operation of a new interim storage for highly-active liquid waste solutions (LAVA) and (c) work in connection with a leakage of a circulation evaporator of the first extraction cycle. (RB).

41677 (KFK–4476, pp. 145-154) **Composition of the residues from irradiated LWR fuel dissolution in nitric acid.** Kleykamp, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

Dissolution tests on irradiated LWR-UO_2 fuel have shown: The mass of the solid residue related to the fuel increases superproportionally with the burn-up; the plutonium fraction, however, is below 0.2% of the residue; the composition of the residue depends on the power of the fuel rod, i.e. on the fuel temperature during irradiation. The predominant fraction in the residue of fuel rods of the normal purer range are fission products which have reprecipitated as hydroxides after nitric acid dissolution; the minor fraction remains undissolved in the residue; the postprecipitations can be explained by radiolytic influences; the relative concentration of the components in the postprecipitations does not correspond to the fission product yield, i.e. the postprecipitations are element-specific; ruthenium is the largest fraction in the residue (about 60% related to the yield). (orig./RB).

41678 (KFK–4476, pp. 155-181) **Iodine desorption from the fuel solution. A comparison of theory and experiment.** Henrich, E. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie); Grimm, R.; Boukis, N.; Finsterwalder, L. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

In the first part of the contribution fundamentals of inorganic iodine chemistry are outlined and simple model concepts for iodine desorption are derived from these. In the second part these working hypotheses are compared with test results from laboratories and technical schools and are then supplemented. Finally, possibilities for improving the iodine desorption are discussed and present activities are presented. (orig.).

41679 (KFK–4476, pp. 183-196) **Experimental comparison of two methods of noble gas retention by rectification or absorption at low temperatures.** Henrich, E. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie); Ammon, R. von. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

For the routine separation of the noble fission gases Xe and Kr from the dissolver off-gas, three methods are of major interest: 1. Rectification after partial liquefaction of the off-gas under pressure; 2. Waste gas cleaning with a non-combustible solvent; 3. Absorption on suitable solid surfaces. A rectification with preliminary O_2 separation and unpressurized noble gas cleaning with CCl_2F_2 has been developed at Karlsruhe Nuclear Research Centre up to the semi-industrial level. Instead of general comparisons, here only these two special process variants are compared with each other on an engineering level based on practical experience. The technical expenditure in preliminary waste gas cleaning is larger in the rectification process due to the O_2 combustion than in noble gas cleaning. This is just the opposite in the cryogenic part of the plant.

Due to simpler pressure and temperature control in the waste gas line a small advantage may remain for noble gas cleaning. Clear advantages for noble gas cleaning are also the safety aspects which have been the initiators for the development: no combustible hydrogen and no large activity reserve under overpressure. (orig./RB).

41680 (KFK–4476, pp. 197-200) **Retention of iodine from the WAK container off-gases.** Furrer, J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)); Kaempffer, R.; Herrmann, F.J.; Nemes, B.; Motoi, V. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

The report deals with the retention of I-129 from the container waste gas of the WAK (reprocessing plant KArlsruhe) using iodine sorption filters with the iodine sorbent AC 6120. These statements are also valid for all the other iodine isotopes such as I-131 and I-133 due to the fact that their chemical behaviour is alike. (orig./RB).

41681 (KFK–4476, pp. 201-219) **Experiments on Pu accumulation during extraction and fission product scrubbing.** Schoen, J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie); Bleyl, H.J.; Hoeffle, G.; Hamburger, E.; Kluth, M.; Schmieder, H.; Wilde, H.; Ertel, D.; Stollenwerk, A. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

The formation of U + Pu accumulations was investigated in order to achieve the specific PUREX-process conditions. To this end, the parameters 'acid concentration in the fission product strip', 'holdup' and 'extractant flow' were varied. The simulation of the experimental results with the aid of the VISCO computing program has proved satisfactory provided that the experiments have reached the steady state; furthermore it was shown for the first extraction column that process disturbances could be detected early with the aid of temperature measurement. (orig./RB).

41682 (KFK–4476, pp. 221-233) **Prevention of Pu accumulation and enhancement of Np and fission product separation.** Petrich, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie); Bleyl, H.J.; Hamburger, E.; Hoeffle, G.; Kolarik, Z.; Schmieder, H.; Schuler, R.; Schwab, P.; Ertel, D. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

A large number of irregular process conditions can be the cause of Pu accumulations in the 1st purex extraction cycle. Experiments and computer calculations for the description and minimization of these accumulations are described. Concentration profiles for uranium, plutonium and neptunium as well as for HNO_3 for a 8-stage mixer-settler cascade were determined in dependence of concentration and temperature. Also Np is subject to a similar accumulation mechanism. Possibilities of improving the flow chart and the Np separation in an electrolytically operated wash extractor are derived from these findings. The behaviour of Zr, Ru and Tc under the new process conditions is also investigated. (RB).

41683 (KFK–4476, pp. 235-254) **Dramatic improvement of Pu/U separation in pulsed columns.** Galla, U. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie); Goldacker, H.; Hamburger, E.; Schlenker, R.; Schmieder, H.; Schwab, P.; Ertel, D.; Tatzel, H. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

The flowsheet for the Pu/U-separation at the reprocessing plant Wackersdorf was successfully demonstrated in the electrochemical reduction column ELKE. The required uranium separation from the Pu product was achieved in the same column with only one meter of 1BS part (U-DF about 200). The stability of the electrochemical reduction process is not disturbed by the presence of technetium (25% of the real feed concentration). By application of two successive electrochemical reduction columns the separation result was improved as drastically as expected. The obtained Pu-DFs of more than 500000 are as regards plutonium in accordance with the final product specifications for uranium. Even in case of an extreme disturbance of the complete hydrazine degradation and the entailed reoxidation, no unduly high Pu concentrations are detected in the organic uranium product after going through a bipartite electrochemical reduction column for more than 30 hours. (orig./RB).

41684 (KFK–4476, pp. 255-266) **Purification of uranium by means of nitrate crystallisation.** Bauder, U. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)); Henrich, E.; Stahl, R. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

Crystallization, which is expected to contribute to a considerable minimization of the waste streams, is tested for the purification and separation of uranium-plutonium and fission products. For this purpose, simulated and real process solutions are used in a testing device with a crystallization vessel, in which a cooling down to -25°C and thus a crystallization of the UNH and a subsequent scrubbing take place. The attained decontamination factors for Pu and fission products are given. The results justify a trial on a semic-industrial scale. There is already a crystallization plant under construction in the MILLI pilot extraction plant to replace the complete purification stages. The flowsheet of the extraction process could be considerably simplified by this. (RB).

41685 (KFK–4476, pp. 267-282) **Development and testing of filters and remote control equipment.** Jannakos, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Ingenieurtechnik); Becka, H.J.; Legner, W.; Mock, H.; Potgeter, G.; Scherer, A.; Furrer, J.; Linek, A. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

A report is given on engineering work for the development, construction and testing of remote controlled filter components and their handling devices. Filter housings of various generations, filter cartridges for the retention of wet and dry aerosols and iodine from process waste gases, control devices for the changing and repairing of filters in a filter cell with lock, compacting and transport devices are described. (RB).

41686 (KFK–4476, pp. 309-317) **Expert-system-supported analytical laboratory for reprocessing.** Jaeschke, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Datenverarbeitung in der Technik); Orth, H.; Zilly, G. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German).

(CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

Besides the measured process values obtained from the in-line/on-line instrumentation, information is obtained off-line from the laboratory analyses which is of equal importance for process control and monitoring of reprocessing. Therefore the laboratory information system is an essential functional component and of special importance for the design, construction and operation of the integrated process information system of the reprocessing plant. Referring to the completed conventional KALAU laboratory information system, the basis of the new, more flexible concept going to be developed as a prototype is that of a hybrid system consisting of a conventional with modules for interactive operation, interactive evaluation, data holding and so on and the CAA expert system (Chemical Analysis Assistant) which accomplishes all disposition functions, controls the conventional components and supplies them with information. (orig./RB).

41687 (KFK–4476, pp. 339-356) **Active neutron measurements on fissile material solutions in the presence of heterogeneous and homogeneous neutron poisons.** Gantner, E. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie); Kuhnes, U.; Trundt, D. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

In connection with the necessity of nuclear materials safeguards the first extraction column (HA column) represents a system component of special importance. It allows the advantageous application of neutron monitoring methods for the detection of fissile material, as neutrons can be detected practically unperturbed even in the presence of the strong γ fields in the HA range. In a test set-up for studies on in-line instrumentation allowing the safe dealing with fissile solutions and a strong neutron source, a large-scale measuring programme was executed with a neutron monitoring set-up installed in an α box and completed in 1987 with a reference measurement on uranium-free nitric acid. The measurement principle, experimental programmes and results are described. (orig./RB).

41688 (KFK–4476, pp. 357-366) **Experiments on iodine analysis in waste material flows.** Mainka, E. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie); Coerdt, W.; Jegle, U.; Wertenbach, H. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

Ion-chromatographic tests for the determination of iodide in waste streams are described. First of all different separation columns which proved successful in the anion determination of Cl^-, SO_4^{2-} and NO_3^- are tested for their usefulness for the iodide analysis. It turned out that even the differences in the anion concentrations of the sample material alone would make a simultaneous determination of all anions impossible. This is due to the fact that iodide must be detected in trace concentrations while the concentrations of Cl^-, SO_4^{2-} and NO_3^- are mostly within the g/l range. It is recommended to use a column of low cross-linking degree as appropriate separation column. The optimal operating conditions for such a column were determined. The detection limit of the analysis method is at $\simeq$ 20 ng/ml for a sample volume of 50 μl. It is largely determined by the variations in blank reading of the chemicals used. (orig./RB).

41689 (KFK–4568) **Separation of the noble metals ruthenium and palladium from nitric acid solution of the nuclear fuel reprocessing containing complexing agents.** Ghafourian, H. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Chemie. Jun 1989. 134p. (In German). Order Number DE89796049/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

Two extraction chromatographic techniques have been developed. N'N diethylthiourea (DETU), which forms complexes with ruthenium that can be retained on an AG50W-X2 ion exchanger, has proved to be a suitable reagent. The structures of these complexes were elucidated by electrophoresis, ion exchange and IR spectroscopy. Under the same conditions Pd forms an insoluble DETU-complex of the formula $[Pd(DETU)_4]^{2+}$, which allows the separation of this metal quantitatively. With regard to the application of the developed technique for recovery of the mentioned noble metals from dissolver residues of the nuclear fuel reprocessing, comparative studies were carried out for accompanying fission product nuclides and actinides such as Mo, Tc, Zr, Ce, U and Pu. It was found out that no complex between diethylthiourea and the fission products zirconium, molybdenum and cerium and the actinides uranium, plutonium and americium were formed. Technetium, which was originally present as pertechnetate, is reduced to Tc(IV) and retained on the cation exchanger together with ruthenium. Ruthenium was eluted with 6 M HNO_3. The efficiency of the developed process has been demonstrated with simulated solutions. The achieved decontamination factors ranged from 10^2 to 10^6 depending on the nuclide. (orig./RB).

41690 (LA–11566-MS) **Corrosion study of simulated evaporator components.** Schreiber, S.B.; Dunn, S.L. Los Alamos National Lab., NM (USA). Jul 1989. 20p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE89015792/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

At the Los Alamos Plutonium Facility, ion exchange effluents and precipitation filtrates containing discardable levels of transuranic elements are concentrated using a thermosiphon evaporator before cement fixation for waste disposal. Because of changing process feed streams and scrap recovery requirements, trace amounts of free chloride ions (Cl^-) are being introduced into the stainless steel (SS) evaporator, potentially increasing corrosion rates and thereby reducing its useful life. This study was performed to determine the effects of Cl^- in simulated evaporator feed solutions that contain significant amounts of ferric ions (Fe^{3+}) in nitric acid (HNO_3). A simulated environment was produced by heating 316 SS cans that contained various tests solutions. The surface was monitored for signs of pitting or stress cracking, and vessel weight loss was measured on a daily basis to establish a rough corrosion rate. The final conclusion is that the nitric acid solution provides enough free nitrate ions (NO_3^-) to maintain minimal corrosion in a dilute ferric chloride environment. 3 refs., 5 figs., 10 tabs.

0509 Transport and Storage

Refer also to citation(s) 41722, 41723, 41725, 41780

41691 (AECL–9077) **Dry storage of used fuel in concrete canisters in Canada.** Truss, K.J.; Patterson, D.W. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 16p. Order Number DE89635420/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The Whiteshell Nuclear Research Establishment (WNRE) initiated a program for dry storage of used CANDU fuel in concrete canisters in 1975. Over the past decade, 17 Mg of fuel have been placed in concrete canister storage at WNRE. In 1985, the WNRE concrete canister design was used for the first time commercially for the interim, on-site storage of 67 Mg of fuel from the Gentilly-1 power reactor at the Gentilly site in the Province of Quebec. This report describes various aspects of this interim storage method. The discussion includes the concept, applications, overall operating experience, licensing aspects, and quality assurance standards and their development.

41692 (INIS-mf–11502, pp. 73-75) **System analysis for supervision on radioisotopes consumers and waste management including transport accidents involving radioactive materials.** Ne'eman, E. Israel Health Physics Society (Israel). 1988. (CONF-8809374–: Israel Health Physics Society annual meeting 1988, Herzliya (Israel), 5-6 Sep 1988). In *Israel Health Physics Society Annual Meeting 1988.* Order Number DE89633078/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Summary only.

0520 Waste Management

Refer also to citation(s) 41467, 41669, 41670, 41674, 41676, 41679, 41688, 41760, 41761, 41767, 41778, 41781, 42249, 42496, 42582, 42638, 42641, 42647, 42656, 42660, 42666, 42677, 42702, 42741, 42916, 43004, 43415, 43443, 43449, 43511, 43516, 43548, 44334, 44342

41693 (AECL–8367) **Assessment of the long-term impact of chemically toxic contaminants from the disposal of nuclear fuel waste.** Goodwin, B.W.; Garisto, N.C.; Barnard, J.W. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 57p. Order Number DE89635606/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

This paper presents a study on the potential for impact on man of chemically toxic contaminants associated with the Canadian concept for the disposal of nuclear fuel waste. The elements of concern are determined through a series of screening criteria such as elemental abundances and solubilities. A systems variability analysis approach is then used to predict the possible concentrations of these elements that may arise in the biosphere. These concentrations are compared with environmental guidelines such as permissible levels in drinking water. Conclusions are made regarding the potential for the chemically toxic contaminants to have an impact on man. 54 refs.

41694 (AECL–8394) **Nonlinear chemical sorption isotherms in the assessment of nuclear fuel waste disposal.** Walker, J.R.; LeNeveu, D.M. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 58p. Order Number DE89635608/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Radionuclides emplaced in an underground disposal vault can possibly migrate from the vault, and through the geosphere, to enter Man's environment. Chemical sorption is a primary mechanism for retarding this migration. The effects of nonlinear chemical sorption isotherms on radionuclide transport are discussed. A method is given by which nonlinear isotherms can be approximated by the linear sorption isotherm used in the vault submodel. The relevance of nonlinear isotherms to transport in the geosphere is discussed, and it is shown that the linear isotherm model is conservative for deep geologic disposal. 22 refs.

41695 (AECL–9064) **Technique to investigate the mechanism of uniform corrosion in the presence of a semi-permeable membrane.** King, F. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 47p. Order Number DE89635610/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A technique to investigate the mechanism of uniform corrosion in the presence of a semi-permeable membrane is described. For both the anodic and cathodic half-reactions three possible rate-determining steps are considered: transport of species through the bulk solution diffusion layer, transport of species through the membrane and the electrochemical reaction itself. The technique is based on the measurement of the corrosion potential, E_{CORR}, of a rotating disc electrode under steady-state conditions. The variation of E_{CORR} with the oxidant concentration, the thickness of the diffusion layer and the membrane thickness is used to identify the rate-determining step for each half-reaction. This technique should be of use in the study of the corrosion behaviour of candidate materials for nuclear waste disposal containers. An understanding of the mechanism of uniform corrosion will enable confident predictions to be made concerning the long-term behaviour of such containers.

41696 (AECL–9075) **Mathematical study of the influence of pore geometry on diffusion.** Melnyk, T.W.; Skeet, A.M.M. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 61p. Order Number DE89635611/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Diffusion into the pore space of plutonic rock matrices is an important phenomenon that can affect the migration of radionuclides and other contaminants in groundwater systems. The effects of irregular pore geometry on rates of diffusive transport are examined in this report. Approximate equations describing steady-state diffusive transport in pores of variable geometry are presented and indicate a strong dependence of the diffusion rates on the geometry of the pore space. Finite-element diffusion calculations were carried out for a series of pores containing storage spaces with rectangular cross-sections. The calculations showed the time taken to reach steady-state is affected by the pore geometry. The results of these calculations were used to simulate typical laboratory diffusion experiments and to evaluate the interpretation of effective diffusion parameters obtained from analysis of the simulated experiments using both capillary and dead-end pore models of the pore space. A capillary model of the pore space requires two independent parameters to characterize the pore space, and is shown, in general, to be inadequate to describe the pre-steady-state regime. The diffusion of radionuclides in groundwater systems lies in this non-steady-state regime. More complex mathematical descriptions of the pore space, using more variables and parameters, can accurately describe the non-steady-state transport. The capillary model, with effective parameter values, gives reasonable results when the size of the dead-end pore space is small relative to the overall diffusion distance under consideration.

41697 (AECL–9082) **Transformation for predicting mechanical changes resulting from time-dependent microcracking in plutonic rock.** Heinrich, W.F. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 19p. Order Number DE89635113/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A transformation for a simple phenomenological model of microcracking is proposed. It relates the evolution of microcrack size in an elastic solid (plutonic rock) under different temporal macro- and microstresses. In this model, for a rock property that changes as a result of microcracking, both the calculated and the experimentally determined evolution of that property for a given stress history can be used to determine the evolution of that property (for the same range) for any other stress history. For example, the transformation can be used to extrapolate the short-term extent of microcracking due to thermally induced stresses to time scales too long for experimental determination. This is of interest in assessing the long-term behaviour of rock surrounding a high level nuclear waste vault, where thermally induced microcracking may take tens of thousands of years to develop. Experimental strategies are suggested for validation of the phenomenological model. Where results are obtained from the corresponding mathematical models, the transformation facilitates the efficient calculation of functions that depend only on the state of microcrack size once the functions have been calculated for any convenient stress history.

41698 (AECL–9091) **Sensitivity analysis in multi-parameter probabilistic systems. An example using the MCROC rock microcracking model.** Walker, J.R. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 31p. Order Number DE89635114/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Probabilistic methods involving the use of multi-parameter Monte Carlo analysis can be applied to a wide range of engineering systems. The output from the Monte Carlo analysis is a probabilistic estimate of the system consequence, which can vary spatially and temporally. Sensitivity analysis aims to examine how the output consequence is influenced by the input parameter values. Sensitivity analysis provides the necessary information so that the engineering properties of the system can be optimized. This report details a package of sensitivity analysis techniques that together form an integrated methodology for the sensitivity analysis of probabilistic systems. The techniques have known confidence limits and

can be applied to a wide range of engineering problems. The sensitivity analysis methodology is illustrated by performing the sensitivity analysis of the MCROC rock microcracking model.

41699 (AECL–9441) **Performance evaluation and operational experience with a semi-automatic monitor for the radiological characterization of low-level wastes.** Davey, E.C.; Csullog, G.W. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Mar 1987. 11p. Order Number DE89635612/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Chalk River Nuclear Laboratories (CRNL) have undertaken a Waste Disposal Project to co-ordinate the transition from the current practice of interim storage to permanent disposal for low-level radioactive wastes (LLW). The strategy of the project is to classify and segregate waste segments according to their hazardous radioactive lifetimes and to emplace them in disposal facilities engineered to isolate and contain them. To support this strategy, a waste characterization program was set up to estimate the volume and radioisotope inventories of the wastes managed by CRNL. A key element of the program is the demonstration of a non-invasive measurement technique for the isotope-specific characterization of solid LLW. This paper describes the approach taken at CRNL for the non-invasive assay of LLW and the field performance and early operational experience with a waste characterization monitor to be used in a waste processing facility.

41700 (AERE-G–5002) **Electrochemical ion-exchange/sorption for medium active liquid waste treatment. Annual progress report 1988.** Turner, A.D.; Bridger, N.J.; Junkison, A.R. UKAEA Harwell Lab. (UK). Materials Development Div. Jan 1989. 6p. Order Number DE89635601/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The 0.1 m^3/h EIX plant has been fully commissioned with zirconium phosphate electrodes using inactive simulant feeds. Cs DFs greater than 5000 have been achieved from 100 ppm Na feeds at greater than 5.5 BV/h to greater than 8% cation loading. After certification for active use, the plant has now been used to treat low level waste. The small DFs achieved for Co (1.7) and Cs (1.3) are attributed to a low initial activity level (37 and 14 mBq/ml, respectively) and an unusually high salt content in this batch of feed, which led to a fall in pH and hence efficiency. This may be rectified by the use of an anion EIX counter electrode. Co DFs greater than 300 have been obtained in experiments on simulant PWR LLW. These will be repeated on genuine waste shortly. A fully scaled-up flow cell has been designed and manufactured as a multi-modular unit to give a performance representative of a much larger plant. Glove box trials on electrosorptive processes for α removal from MLW have identified three promising approaches. Flow cell tests with ZrP EIX (as for $B\gamma$) have reduced Pu and Am to below 1 Bq/ml with DFs of 23-75 for dilute acid streams. While high salt contents reduce the effectiveness of this technique, a hybrid IX absorption/electrochemical system is showing promise for such feeds. Sorption of a α activity onto electrolytically grown oxide films on Ti mesh electrodes has demonstrated Kd greater than 10^4. Quantitative recovery is achieved into dilute acid on polarity reversal. Methods of preparing thick films are currently being investigated. (Author).

41701 (CONF-890854–7) **DOE Hazardous Waste Remedial Actions Program (HAZWRAP) waste technology demonstration program.** Adams, R.E. Oak Ridge National Lab., TN (USA). Hazwrap Support Contractor Office. [1989]. 26p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. From 11. annual DOE low level waste management conference; 22-24 Aug 1989. Order Number DE89015362/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

One function of the Department of Energy (DOE) Hazardous Waste Remedial Actions Program (HAZWRAP) is to support the field demonstration of waste treatment technologies, both in-house and commercial, to determine the applicability of these technologies in remediating waste problems common the DOE Defense Programs (DP) installations. A number of innovative technologies have the potential for dealing with DOE-DP Comprehensive Environmental Response, Compensation, and Liability Act-related and Resource Conservation and Recovery Act-related waste problems more economically and/or in a more socially acceptable manner than do current processes. It is the goal of HAZWRAP to critically review emerging technologies and to demonstrate those with the greatest potential for significant effect on the DOE-DP waste management program.

41702 (CONF-8908104–1) **A system optimization model for low-level nuclear waste disposal.** Chang, Shoou-Yuh; Rivera, A.L. Oak Ridge National Lab., TN (USA). 1989. 35p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. From 7. international conference on mathematical and computer modelling; Chicago, IL (USA); 2-5 Aug 1989. Order Number DE89015869/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The development of waste management systems for the disposal of low-level radioactive waste (LLW) is becoming an increasingly complex problem in decision-making. The complexity is the result of increasing considerations for the protection of water quality and remedial actions for system failures. The process becomes more complex as the points of regulatory compliance are moving closer to the disposal unit instead of the boundary of disposal site. This trend would result in every disposal unit being regulated as a discharge point, similar to the National Pollutant Discharge Elimination System (NPDES). The Oak Ridge Reservation (ORR) is in the process of developing a disposal complex for solid LLW. The complex will be a combination of disposal sites, disposal units, and disposal unit technology. Disposal unit technology includes the waste package (waste form and disposal container) and other engineered barriers added to the trench to prevent or control the transfer of radionuclides from the disposal unit into the environment. The combination of waste inventory and engineered barriers is called a waste facility. The waste facility is viewed as a confinement systems and is the focal point in waste confinement studies. 24 refs., 10 figs.

41703 (DOE/ID–22079) **Hydrological and meteorological data for an unsaturated zone study near the radioactive waste management complex, Idaho National Engineering Laboratory, Idaho: 1985–86.** Pittman, J.R. Geological Survey, Idaho Falls, ID (USA). Apr 1989. 180p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (MISC–89059;USGS-OFR–89-74). Order Number DE89016171/JAW. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

The hydrologic properties of the unsaturated zone and amount of net recharge to the system must be determined to field-calibrate a mathematical model to predict the long-term migration of radionuclides in the unsaturated zone. This study is being conducted to provide that necessary data for a specific area. Radioactive waste has been buried at the RWMC (Radioactive Waste Management Complex) at the INEL (Idaho National Engineering Laboratory) since 1952. In 1985, the US Geological Survey and EG&G Idaho, Inc., in cooperation with the US Department of Energy, began a study of the geohydrology of the RWMC to provide a basis for estimating the extent of and the potential for migration of radionuclides in the unsaturated zone beneath the waste burial trenches and pits. Two test trenches were installed in the surficial sediment adjacent to the RWMC burial ground to collect hydrologic data from undisturbed and disturbed soil. Hydrologic data collected during 1985 and 1986 included measurements, taken every 12 hours, of soil temperature and soil-water potential from 30 sensors placed at selected depths to about 6 meters using thermocouple psychrometers; and soil-moisture content measurements collected weekly in 9 neutron-probe access holes with a neutron moisture depth gage. Meteorological data averaged every 6 hours included wind speed, wind direction, relative humidity, air temperature; solar radiation and precipitation were totaled over the 6-hour period. 18 refs., 14 figs., 19 tabs.

41704 (DOE/LLW–81) **Recommended format and content for DOE Low-Level Waste Disposal Facility radiological performance assessment reports.** Case, M.J.; Dodge, R.L.; Frangos, T.G.; Hansen, W.R.; Kennedy, W.E. Jr.; Layton, D.W.; Lee, D.W.; Wilhite, E.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). Apr 1989. 6p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (MISC–89037). Order Number DE89016357/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

As required by DOE Order 5820.2A, an Oversight and Peer Review Panel has been formed to review radiological performance assessments for disposal of low-level radioactive waste at DOE

facilities. The Panel has prepared this report, which contains a recommended format and content for radiological performance assessment reports for Department of Energy sites, to promote consistency in preparation of the assessments and to facilitate Panel review. In addition to the recommended format and content, the Panel recommends the use guides for planning and executing the performance assessment.

41705 (DOE/NE/44139–46) **Design, construction, and operation of the contact size reduction facility at the West Valley Demonstration Project.** Frank, D.E.; Reeves, S.R.; Valenti, P.J. West Valley Nuclear Services Co., Inc., West Valley, NY (USA). May 1988. 24p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-81NE44139. Order Number DE89015388/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper describes the design, construction and initial operation of the Contact-Handled Size Reduction Facility (CSRF) at the West Valley Demonstration Project. The facility was constructed to size reduce contaminated tanks, piping, and other metallic scrap and package the scrap for disposal. In addition, the CSRF has the capability to decontaminate scrap prior to disposal. The anticipated result of decontaminating the scrap is to reduce waste classified as transuranic or low-level Class B and C to Class A or release for unrestricted use as nonradioactive equipment. 10 figs., 1 tab.

41706 (DOE/NV/10576–T3) **Assessment of faulting and seismic hazards at Yucca Mountain.** King, J.L.; Frazier, G.A.; Grant, T.A. Science Applications International Corp., Las Vegas, NV (USA). 2 Jun 1989. 26p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC08-87NV10576. Order Number DE89016000/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Yucca Mountain is being evaluated for the nation's first high-level nuclear-waste repository. Local faults appear to be capable of moderate earthquakes at recurrence intervals of tens of thousands of years. The major issues identified for the preclosure phase (<100 yrs) are the location and seismic design of surface facilities for handling incoming waste. It is planned to address surface fault rupture by locating facilities where no discernible recent (<100,000 yrs) faulting has occurred and to base the ground motion design on hypothetical earthquakes, postulated on nearby faults, that represent 10,000 yrs of average cumulative displacement. The major tectonic issues identified for the postclosure phase (10,000 yrs) are volcanism (not addressed here) and potential changes to the hydrologic system resulting from a local faulting event which could trigger potential thermal, mechanical, and chemical interactions with the ground water. Extensive studies are planned for resolving these issues. 33 refs., 3 figs.

41707 (DOE/NV/10630–4) **Probabilistic risk assessment for greater confinement disposal.** Cox, N.D.; Atwood, C.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). Oct 1988. 91p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-89NV10630;AC07-76ID01570. Order Number DE89016250/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Risks arising from two aspects of disposing radioactive waste at the Nevada Test Site (NTS) are analyzed in this report. The first aspect concerns occupational exposures received during handling and disposal of high-specific-activity low-level waste (HSA-LLW) in augered boreholes used to ensure greater confinement. The second aspect concerns the threat to the public from waste after disposal in augered boreholes. The risk assessment for HSA-LLW confirms that procedures for, and operations of, future augered borehole disposal sites will provide a safe and effective way to dispose of this type of waste. Augered borehole disposal operations are conducted at minimal, or near minimal, occupational radiation levels for site personnel. Contingency plans to recover from equipment failure are well thought out and, if executed as planned, will keep personnel radiation exposures within tolerable limits. The risk to the public from waste that has been disposed in augered boreholes was identified as a result of tritium seepage from disposal packages. The resulting committed dose equivalents were calculated using conservative assumptions. If one new hole is filled each year, the annual dose equivalent to an individual living full-time near the disposal site is on the order of 0.2 mrem, well below the regulatory limit of 25 mrem. The annual dose equivalent to an average individual is much smaller, approximately 0.001 mrem. The probability of a harmful health effect to either individual is negligible compared to other risks that are encountered in everyday life. 21 refs., 4 figs., 13 tabs.

41708 (DOE/OR/21479–T1) **Pilot internship program on radioactive waste at Vanderbilt University: Progress report, September 1, 1987 to August 31, 1988.** Vanderbilt Univ., Nashville, TN (USA). [1988]. 25p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract FG05-84OR21479. Order Number DE89016438/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The fourth year of the program began with the selection of the new interns. Mailings were sent to prospective graduate students and rising juniors at Vanderbilt University with grade point averages of 3.0 or better (out of 4.0) advertising the availability of internships in radioactive waste disposal. New interns were selected. All of the interns selected in the fourth year chose to return to Vanderbilt after their field assignment.

41709 (EGG-M–89157) **Offgas treatment.** Steverson, E.M. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1989]. 34p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-890521–12: 8. international conference on thermal destruction of hazardous, radioactive, infectious and mixed wastes, 1-5 May 1989). Order Number DE89016196/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

The incineration of waste materials, almost without regard to the type of waste, requires the use of air pollution control devices (APCDs) or offgas systems. The ability to properly clean offgases of potentially harmful contaminants is certainly required to legally operate but it is also necessary to protect health and the environment and gain public acceptance. Many factors are considered in the design of an effective offgas system including waste characteristics (offgas contaminants), emissions regulations, location, public opinion, water treatment availability, budget, and incinerator type. Fortunately, there are numerous offgas system components to choose from and many possible combinations of components to fit the many specific needs. The selection of the best system for a given application requires an understanding of the technologies available and their advantages and disadvantages. This overview of incinerator offgas systems will give the participant a very basic understanding of the factors involved in choosing an offgas system and the components and combinations available. 7 refs., 14 figs., 4 tabs.

41710 (EPRI-NP–5684) **Below Regulatory Conern Owners Group: Radiologic impact of accidents and unexpected events from disposal of BRC waste: Final report.** Waite, D.A.; Dolan, M.M.; Rish, W.R.; Rossi, A.J.; McCourt, J.E. Electric Power Research Inst., Palo Alto, CA (USA); Envirosphere Co., Bellevue, WA (USA). c Jul 1989. 86p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report determines the radiological impact of accidents and unexpected events in the disposal of Below Regulatory Concern (BRC) waste. The accident analysis considers the transportation, incineration, and disposal of BRC waste as municipal solid waste. The potential greatest radiological impact for each type of accident is identified through the use of event trees. These accident events are described in terms of the generic waste property(ies) (e.g., flammability, dispersibility, leachability, and solubility) that cause the greatest radiological impact. 7 refs., 32 figs., 12 tabs.

41711 (INFO–0195-2) **Waste management implications of concentrating slimes. Effect of management practices.** Atomic Energy Control Board, Ottawa, ON (Canada); Beak Consultants Ltd., Toronto, ON (Canada); Golder Associates, Toronto, ON (Canada). Feb 1988. 86p. Order Number DE89635602/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The anticipated increase in demand for sand-size tailings from the uranium industry suggests that the fine-grained or 'slime' fraction will require special attention for disposal. The Atomic Energy Control Board (AECB) required information on the behaviour and environmental significance of the fine-grained tailings fraction in disposal facilities. Beak Consultants and Golder Associates were contracted to review the significant characteristics of slimes disposal and prepare a report on the physical and chemical characteristics of

fine-grained tailings (Phase 1). This report (Phase 2) presents a summary of disposal and management practices for slimes and outlines potential concerns related to these practices. The report also presents an approach to disposal planning and the implications of available and potential management techniques. Experience with the disposal of uranium slimes is scarce and, therefore, relevant information was borrowed from the other mining sectors to predict the consequences of various disposal scenarios.

41712 (INFO–0267) **Optimization of protection as a decision-making tool for radioactive waste disposal.** Bragg, K. Atomic Energy Control Board, Ottawa, ON (Canada). Mar 1988. 17p. Order Number DE89635617/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This paper discusses whether optimization of radiation protection is a workable or helpful concept or tool with respect to decisions in the field of long-term radioactive waste management. Examples of three waste types (high-level, low-level and uranium mine tailings) are used to illustrate that actual decisions are made taking account of more complex factors and that optimization of protection plays a relatively minor role. It is thus concluded that it is not a useful general tool for waste management decision-making. Discussion of the nature of the differences between technical and non-technical factors is also presented along with suggestions to help facilitate future decision-making.

41713 (INIS-mf–11483, pp. 13) **Problems of radioactive wastes deposition in Hungary.** Viragh, E. (Technical Univ., Budapest (Hungary). Inst. of Nuclear Technics). Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

41714 (INIS-mf–11508) **Key Lake mine water spill: further clean-up not required.** Potvin, R. Atomic Energy Control Board, Ottawa, ON (Canada). Feb 1984. 4p. (In English, French). Order Number DE89635618/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

French version included. News release 84-3.

The Atomic Energy Control Board (AECB) has concluded that no additional remedial measures are warranted with regard to the mine water spill which occurred in early January at the Key Lake Mining Corporation facility in northern Saskatchewan, and has advised the company to reconsider its proposal for clean-up of the adjoining Gerald Lake basin. On January 5, an estimated 87 million litres of mine water was accidentally released to the environment when a water storage reservoir at the mine site overflowed. The spilled water flowed into the adjoining Gerald Lake catchment area where it has remained adequately contained.

41715 (INIS-mf–11511) **Measurement of magnetic susceptibility on tailings cores report on cores obtained from the Ontario Research Foundation lysimeter experiment.** Canada Centre for Mineral and Energy Technology, Ottawa, ON (Canada). Oct 1984. 88p. Order Number DE89635619/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Bulk susceptibility and induced magnetic remanence results are reported for 40 cores obtained from the uranium tailings lysimeter experiment at the Ontario Research Foundation. Both methods indicate a broad threefold subdivision of the tailings pile. An upper zone is characterized by an enhanced susceptibility level, which is related to enhanced concentration of both magnetite and hematite. Depletion zones, where present, are of limited areal extent and strongly developed. An intermediate zone is characterized by a mixture of large areas of reduced susceptibility that separate smaller regions of slightly enhanced susceptibility. The zones of susceptibility depletion appear to define a dendritic drainage pattern. Locally in this zone magnetite is enhanced and hematite depleted. In the lowermost zone susceptibility levels are reduced over most of the tailings bed. Only in the upper most right hand corner is there any vestige of a positive susceptibility concentration. Both magnetite and hematite are strongly depleted in this lower zone. Visually it is apparent that this lowermost depleted zone correlates to the zones of strongest 'yellowcake' development.

41716 (INIS-mf–11989, pp. 223) **Redox reactions of actinide ions with radiolytically produced chlorine species.** Lierse, C. (Pruefinstitut fuer Radioaktivitaet in Technik und Umwelt GmbH, Muenchen (Germany, F.R.)); Kim, J.I.; Sullivan, J.C.; Schmidt, K.H. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

41717 (INIS-mf–11989, pp. 223) **Radionuclide migration in the environment.** Gunten, H.R. von (Paul Scherrer Inst., Villigen (Switzerland)). Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

41718 (INIS-mf–11989, pp. 223) **Utilization of gamma spectrometry and ICP/AES for the monitoring of plutonium recovery from intractable residues.** Heinrich, R.R. (Argonne National Lab., IL (USA). Analytical Chemistry Lab.); Streets, W.E.; Bowers, D.L.; Sabau, C.S. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

41719 (INIS-mf–11989, pp. 223) **Mechanistic studies of organic diagenesis in simulated nuclear wastes.** Toste, A.P. (Southwest Missouri State Univ., Springfield, MO (USA). Chemistry Dept.); Crabtree, A.M.; Osborn, B.C.; Perez, G.C. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

41720 (Juel-Conf–69, pp. 158-171) **BATAN activities in radwaste management.** Ronodirdjo, S. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct 1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

A comprehensive programme of research and development on radioactive waste management has been already well defined to meet the requirements for the future nuclear science and technology development in Indonesia as technical support of routine work for quality improvement to ensure that the processed low and medium wastes could be stored ultimately in shallow ground repositories safely and economically. The interim spent fuel facility (ISFSF) will be constructed at Serpong to provide space for interim storage of irradiated fuel elements and high activated used components which are accumulated during 30 years of MPR-30 operation. (orig./DG).

41721 (Juel-Conf–69, pp. 172-179) **Factors to be considered in establishing a radwaste management system.** Krause, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik). Kernforschungsanlage Juelich

G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct 1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

In establishing a radwaste management system the general objectives of the waste treatment facilities, the environmental conditions influencing the layout, the impact of waste disposal options, the factors influencing the capacity, and time aspects involved in the establishment of a waste management system have to be considered. Their influence on the general concept and on the layout of particular plants are discussed. (DG).

41722 (Juel-Conf–69, pp. 180-195) **Principles of and experience in low level, medium level and TRU element bearing radioactive waste treatment.** Krause, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct 1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

The treatment of low and medium level liquid and solid wastes, of off-gas and exhaust air, of TRU wastes, and the conditioning of low and medium level liquid waste concentrates, as used in the Nuclear Research Center of Karlsruhe, are described. The transport of low level solid and liquid wastes is done by trucks with concrete and steel containers. The interim storage of low and medium level solid wastes is carried out in simple store houses with a decontaminable floor or buildings with shielded walls and remote handling devices. (DG).

41723 (Juel-Conf–69, pp. 196-211) **Characterization of low and intermediate level waste forms - qualification for interim storage, transport, and disposal.** Koester, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct 1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

The main objective of the characterization work performed at the Kernforschungszentrum Karlsruhe was to establish source term formulations for the cemented waste forms as input for safety analysis. For the operation phase of a repository radionuclide mobilization from the waste packages via the gas phase, caused by mechanical or thermal impact has to be considered. For this reason, besides laboratory tests, experiments with inactive full scale samples were performed (200 l and 400 l drums) to determine quantitatively the activity release from the waste packages under defined thermal and mechanical stresses. In order to evaluate source terms for the mobilization of relevant radionuclides via the liquid phase (post operation phase of the repository) as a function of time due to leaching and corrosion, detailed experimental work with simulated inactive and doped (Cs-137, Sr-90, Pu, Am) laboratory samples and with inactive full scale samples was performed. The experimental work was accompanied by theoretical investigations to establish an improved basis for long term predictions. (orig./DG).

41724 (Juel-Conf–69, pp. 212-229) **Disposal strategies for radioactive waste - experience in the Federal Republic of Germany.** Stoeber, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct 1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

A survey is given on the situation of nuclear technology in the Federal Republic of Germany (FRG) with regard to management and disposal of radioactive waste. Factors to be considered and implementation of disposal programs are briefly described. (orig.).

41725 (KFK–4476, pp. 33-50) **Nuclear waste management in Germany today - status and trends.** Weinlaender, W. (Deutsche Gesellschaft fuer Wiederaufarbeitung von Kernbrennstoffen m.b.H. (DWK), Hannover (Germany, F.R.)). Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

The integrated disposal concept of the Federal Government involves interim stores for fuel elements in Gorleben and Ahaus and the large reprocessing plant in Wackersdorf with a store for arriving fuel elements, whose technical status as well as the state of the licensing procedures are reported in this article. The development work by the Karlsruhe Nuclear Research Centre accompanying the planning process on the test benches in Lahde and in the TEKO as well as in the WAK and PAMELA enterprises is briefly dealt with. (RB).

41726 (KFK–4476, pp. 69-83) **INE R and D activities in the field of radioactive waste management.** Krause, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

The work of the Institut fuer Nukleare Entsorgungstechnik (INE) covered: Development and demonstration of technical processes for radioactive waste treatment; auxiliary laboratory studies for the purpose of understanding and optimizing the chemical and physical components of the technical processes; development of novel waste treatment processes and products; investigation of the behaviour of radioactive waste during interim storage, transport, and final storage, including studies on the processes in the vicinity of a final storage site. The results obtained in the working groups are briefly reported. (orig.).

41727 (KFK–4476, pp. 367-391) **Chemical processes during HAWC vitrification: Investigations using a liquid-fed laboratory melting apparatus.** Kelm, M.; Pentinghaus, H.; Oser, B. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

The laboratory melting device has proved to be a very efficient tool for clearing up the chemico-physical processes in a ceramic melting device. The previous results from the first three vitrification campaigns have not shown any insurmountable problems in the HAWC vitrification in a ceramic melting device with liquid feed. The work on the formation of the Yellow Phase and on the formation of nobble metal suspensions in the melting device, however, must be continued because of its significance for the service life and the performance of the melting device. (orig./RB).

41728 (KFK–4476, pp. 393-407) **Precipitation, one stage in the conditioning of medium-activity liquid waste.** Gompper, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik); Kunze, S. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German).

(CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

It was the objective of this work to separate the transuranic elements and the fission products from the MAWC as far as is necessary to obtain a lightly radioactive waste product largely free from alpha particles which requires no shielding after its solidification. The two Cs isotopes 134 and 137 are responsible for more than 80% of the dose rate although they contribute hardly by more than 50% to the total activity. Eu-154 follows with about 15% and Sb and Ru with together about 3%. A cost-effective precipitation method appropriate for the flow sheet of the reprocessing plant uses nickel hexacyanoferrate(II) as reagent for Cs and iron hydroxide for Sb and Ru. Lanthanides and actinides are coprecipitated. (orig./RB).

41729 (KFK–4476, pp. 409-422) **Chromatographic decontamination of medium-activity waste concentrates.** Faubel, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie); Menzler, P.M.; Sameh, A.A. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

The chromatographic decontamination of a MAW concentrate was carried out in a laboratory plant in 1-l-batches in the following way: In order to purify the nitric MAW concentrate from its solid and organic contamination products, it is passed through a filter and an absorber (SM7) for organic species. Subsequently the purified solution runs on-line through all following columns. First the main activity carrier cesium (^{137}Cs, ^{134}Cs) is transferred to ammonium molybdate phosphate (AMP-1) by means of a newly developed fluidized bed process. In the further course, ^{125}Sb is separated on metal oxides (Sb_2O_5, MnO_2) and the three-valued actinides/lanthanides on an extraction-chromatographic CMPO column. Finally the remaining ^{106}Ru and ^{60}Co activities are separated on dimethylglyoximes (DMG) coated on active carbon. (orig./RB).

41730 (KFK–4476, pp. 423-434) **Studies on tritium depletion from liquid waste solutions by the CECE process.** Berndt, U. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie); Kirste, E.; Sameh, A.A. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

About 2 m^3 of water with a tritium concentration of about $3.7x10^9$ Bq/l result from one ton of fuel reprocessed in a reprocessing plant. For reasons of cost they are split up in a large fraction depleted of T and a small fraction rich in T. A method developed for this purpose, i.e. the CECE method (Combined Electrolysis and Catalytic Exchange), and the plant belonging to it are described. Experiments on T-depletion with regard to its dependence on temperature, service life, H_2 throughput, time of contact and water recycling were carried out. The results are given. Design data on a technologically relevant scale for a CECE plant were gained from the laboratory experiments. (RB).

41731 (KFK–4476, pp. 435-452) **Development of conditioning processes for waste claddings and structural materials from LWR fuel reprocessing.** Frotscher, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Ingenieurtechnik); Boehme, G. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

Within the framework of the reprocessing and waste treatment project, Karsruhe Nuclear Research Center worked on the improvement of conditioning methods for pipe sleeves and structural materials. The method for the production of sleeves/concrete products in 200 l casks shows disadvantages with regard to a hydrogen release and the possible production and accumulation of ultrafine pyrophorous zircaloy parts in the hot cell. An alternative method has been under development since 1985. The waste is stratified by axial cold-pressing and packed without matrix in PAMELA moulds or COGEMA moulds. Initial experience with this new conditioning concept is presented. (RB).

41732 (KFK–4476, pp. 453-463) **Powder-technological vitrification of HAW from LWR and FBR reprocessing.** Gahlert, S. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung); Ondracek, G. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

Whereas (simulated) HLW is denitrified first, (simulated) FKS is directly mixed with glas frit and dryed in oil heated mixers. After calcination within the highgrade steel mould at a temperature of 850 or 950 K (depending on the type of glass and waste), the mixture is sintered for several hours under pressures between 0.4 and 1.0 MPa and at temperatures of 920 or 1020 K. The low process temperature and the prevention of the liquid phase result in (I) the reduction of the waste steam loss, (II) the prevention of segregations and problems with corrosions, (III) the reduction of the dependency of the product properties on the changes in the waste composition and loading, (IV) the possible use of higher-melting glasses of higher leaching resistance. The procedure has been demonstrated inactively for diameters of up to 30 cm; for the application in hot operation adaption measures may be required. (orig.).

41733 (LBL–22860) **Thermodynamic tables for nuclear waste isolation: Vol. 1, Aqueous solutions database.** Phillips, S.L.; Hale, F.V.; Silvester, L.F.; Siegel, M.D. Lawrence Berkeley Lab., CA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of High-Level Waste Management; Sandia National Labs., Albuquerque, NM (USA). May 1988. 181p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098;AC04-76DP00789. (NUREG/CR–4864-Vol.1;SAND–87-0323). Available from NTIS, PC A09/MF A01 - GPO - OSTI.

Tables of consistent thermodynamic property values for nuclear waste isolation are given. The tables include critically assessed values for Gibbs energy of formation, enthalpy of formation, entropy and heat capacity for minerals; solids; aqueous ions; ion pairs and complex ions of selected actinide and fission decay products at 25°C and zero ionic strength. These intrinsic data are used to calculate equilibrium constants and standard potentials which are compared with typical experimental measurements and other work. Recommendations for additional research are given. 13 figs., 23 tabs.

41734 (NSS/G–106) **Biosphere: current status.** Thorne, M.C. United Kingdom Nirex, Ltd., Harwell (UK). Jun 1988. 36p. (HL–89/1085). Order Number DE89635620/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This paper outlines the biosphere models and data required to assess the post-closure radiological impact of deep geological repositories for low and intermediate level radioactive wastes. It then goes on to show how these requirements are being met either within the Nirex Safety Assessment Research Programme or from other research programmes. (Author).

41735 (NUKEM-FuE–85039) **Quality monitoring of LAW/MAW waste forms. Final report.** Brunner, H.; Ganser, B.; Iffland, N. Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Hanau (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Nov 1986. 200p. (In German). Contract BMFT KWA 5213 5. Available from Copy held by UB/TIB Hannover.

During the R and D program on quality assurance, started in 1979 and carried on in 1982-85 by NUKEM, experimental tests for ensuring the final storage of low level and medium level radioactive waste were carried out. The focal point was the characterization of the cemented and other forms of solid waste from reprocessing and the quality assurance by means of process control and product control, especially with regard to the planned ultimate disposal of the waste in the Konrad and Gorleben repositories. The studies comprised investigations in inactively simulated waste forms on the laboratory scale and on the 1:1 scale. (orig./RB).

41736 (NUREG–1375-Vol.1) **Safety evaluation status report for the prototype license application safety analysis report: Earth-mounted concrete bunker.** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. Jul 1989. 88p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A05/MF A01 - GPO - OSTI.

The US Nuclear Regulatory Commission (NRC) staff and consultants reviewed a Prototype License Application Safety Analysis Report (PLASAR) submitted by the US Department of Energy (DOE) for the earth-mounded concrete bunker (EMCB) alternative method of low-level radioactive waste disposal. The NRC reviewers relied extensively on the Standard Review Plan (SRP), Rev.1 (NUREG-1200), to evaluate the acceptability of the information provided in the EMCB PLASAR. The NRC staff selected certain review areas in the PLASAR for development of safety evaluation report input to provide examples of safety assessments that are necessary as part of a licensing review. Because of the fictitious nature of the assumed disposal site, and the decision to limit the review to essentially first-round review status, the NRC staff report is labeled a "Safety Evaluation Status Report" (SESR). Appendix A comprises the NRC review comments and questions on the information that DOE submitted in the PLASAR. The NRC concentrated its review on the design and operations-related portions of the EMCB PLASAR.

41737 (NUTP–1E) **Uranium tailings sampling manual.** Feenstra, S.; Reades, D.W.; Cherry, J.A.; Chambers, D.B.; Case, G.G.; Ibbotson, B.G. Canada Centre for Mineral and Energy Technology, Ottawa, ON (Canada). Mining Research Labs. 1985. 95p. Order Number DE89635621/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The purpose of this manual is to describe the requisite sampling procedures for the application of uniform high-quality standards to detailed geotechnical, hydrogeological, geochemical and air quality measurements at Canadian uranium tailings disposal sites. The selection and implementation of applicable sampling procedures for such measurements at uranium tailings disposal sites are complicated by two primary factors. Firstly, the physical and chemical nature of uranium mine tailings and effluent is considerably different from natural soil materials and natural waters. Consequently, many conventional methods for the collection and analysis of natural soils and waters are not directly applicable to tailings. Secondly, there is a wide range in the physical and chemical nature of uranium tailings. The composition of the ore, the milling process, the nature of tailings depositon, and effluent treatment vary considerably and are highly site-specific. Therefore, the definition and implementation of sampling programs for uranium tailings disposal sites require considerable evaluation, and often innovation, to ensure that appropriate sampling and analysis methods are used which provide the flexibility to take into account site-specific considerations. The following chapters describe the objective and scope of a sampling program, preliminary data collection, and the procedures for sampling of tailings solids, surface water and seepage, tailings pore-water, and wind-blown dust and radon.

41738 (OH–85-98-K) **Progress in welding studies for Canadian nuclear fuel waste disposal containers.** Maak, P.Y.Y. Ontario Hydro, Toronto, ON (Canada). Research Center. Nov 1985. 31p. Order Number DE89635623/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This report describes the progress in the development of closure-welding technology for Canadian nuclear fuel waste disposal containers. Titanium, copper and Inconel 625 are being investigated as candidate materials for fabrication of these containers. Gas-tungsten-arc welding, gas metal-arc-welding, resistance-heated diffusion bonding and electron beam welding have been evaluated as candidate closure welding processes. Characteristic weldment properties, relative merits of welding techniques, suitable weld joint configurations and fit-up tolerances, and welding parameter control ranges have been identified for various container designs. Furthermore, the automation requirements for candidate welding processes have been assessed. Progress in the development of a computer-controlled remote gas-shielded arc welding system is described.

41739 (OH–85-271-K) **Microbial effects. Radioactive waste disposal summary report.** Sharpe, V.J. Ontario Hydro, Toronto, ON (Canada). Research Center. Oct 1985. 23p. Order Number DE89635622/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The long term safety and integrity of radioactive waste disposal sites proposed for use by Ontario Hydro may be affected by the release of radioactive gases. Microbes mediate the primary pathways of waste degradation and hence an assessment of their potential to produce gaseous end products from the breakdown of low level waste was performed. Due to a number of unknown variables, assumptions were made regarding environmental and waste conditions that controlled microbial activity; however, it was concluded that ^{14}C and ^{3}H would be produced, albeit over a long time scale of about 1500 years for ^{14}C in the worst case situation.

41740 (PNL–6820-Vol.1) **Hydrogeology of the 200 Areas low-level burial grounds: An interim report: Volume 1, Text.** Last, G.V.; Bjornstad, B.N.; Bergeron, M.P.; Wallace, D.W.; Newcomer, D.R.; Schramke, J.A.; Chamness, M.A.; Cline, C.S.; Airhart, S.P.; Wilbur, J.S. Pacific Northwest Lab., Richland, WA (USA). Jan 1989. 261p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE89014008/JAW. Available from NTIS, PC A12/MF A01 - OSTI; GPO Dep.

This report presents information derived from the installation of 35 ground-water monitoring wells around six low-level radioactive/hazardous waste burial grounds located in the 200 Areas of the Hanford Site in southeastern Washington State. This information was collected between May 20, 1987 and August 1, 1988. The contents of this report have been divided into two volumes. This volume contains the main text. Volume 2 contains the appendixes, including data and supporting information that verify content and results found in the main text. This report documents information collected by the Pacific Northwest Laboratory at the request of Westinghouse Hanford Company. Presented in this report are the preliminary interpretations of the hydrogeologic environment of six low-level burial grounds, which comprise four waste management areas (WMAs) located in the 200 Areas of the Hanford Site. This information and its accompanying interpretations were derived from sampling and testing activities associated with the construction of 35 ground-water monitoring wells as well as a multitude of previously existing boreholes. The new monitoring wells were installed as part of a ground-water monitoring program initiated in 1986. This ground-water monitoring program is based on requirements for interim status facilities in compliance with the Resource Conservation and Recovery Act (1976).

41741 (PNL–6820-Vol.2) **Hydrogeology of the 200 Areas low-level burial grounds: An interim report: Volume 2, Appendixes.** Last, G.V.; Bjornstad, B.N.; Bergeron, M.P.; Wallace, D.W.; Newcomer, D.R.; Schramke, J.A.; Chamness, M.A.; Cline, C.S.; Airhart, S.P.; Wilbur, J.S. Pacific Northwest Lab., Richland, WA (USA). Jan 1989. 770p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE89014005/JAW. Available from NTIS, PC A99/MF A01 - OSTI.

This report presents information derived form the installation of 35 ground-water monitoring wells around six low-level radioactive/hazardous waste burial grounds located in the 200 Areas of the Hanford Site in southeastern Washington State. This information was collected between May 20, 1987 and August 1, 1988. The contents of this report have been divided into two volumes. Volume 1 contains the main text. This Volume contains the appendixes,

including data and supporting information that verify content and results found in the main text.

41742 (REG/G–3.64) **Calculation of radon flux attenuation by earthen uranium mill tailings covers.** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. Jun 1989. 42p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A03/MF A01 - GPO - OSTI.

This regulatory guide describes methods acceptable to the NRC staff for calculating radon fluxes through earthen covers and for calculating the resulting minimum cover thickness needed to meet NRC and EPA standards. The guide also suggests methods for obtaining the various parameters used in calculating the radon fluxes and earthen cover thicknesses and suggests default values for certain parameters. This regulatory guide is applicable to active uranium tailings sites. The NRC staff is using the methods stated in this guide as a basis for review and concurrence of DOE remedial action plans for inactive sites. The guidance is intended to be used for calculating radon flux attenuation by earthen uranium mill tailings covers. The parameter values and examples presented are limited to earthen cover materials, but the diffusion theory and the methods presented are also applicable to man-made materials. Detailed supporting information for calculating minimum cover thickness is published separately in the "Radon Attenuation Handbook for Uranium Mill Tailings Cover Design," NUREG/CR-3533 (Ref. 1).

41743 (SAND–88-2948) **Advances in resolution of discrepancies between predicted and measured in situ WIPP [Waste Isolation Pilot Plant] room closures.** Munson, D.E.; Fossum, A.F.; Senseny, P.E. Sandia National Labs., Albuquerque, NM (USA). Feb 1989. 77p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89015193/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

An extensive reevaluation has been made of several major aspects of the simulation of the structural response of salt to improve the ability to represent actual deformations. As a result of the effort, it is now evident that the Tresca flow potential represents the behavior of salt. The previously used von Mises flow potential does not appear to be appropriate. The multimechanism steady state, workhardening/recovery transient (M-D) model now has been modified to be more representative of salt creep. Reevaluation of material parameters, based on new creep data and a better conceptual understanding of construction of the virgin state parameters has resulted in significant improvement in the material parameters available for calculation. In addition, reevaluation of the coefficient of friction on clay seams was found necessary. Actual underground observations also suggested a revised stratigraphic sequence at the WIPP facility horizon. The combination of the above improvements, when incorporated into a numerical simulation of the closure response of an underground test room (Room D), produced excellent agreement between calculated and measured closures. The agreement between the calculated and measured vertical closures is within 2% for the nearly 4.4 years represented by the experimental data. Agreement between the calculated and measured horizontal closures is not quite as good, with the calculation overpredicting the observed closure by 18%. However, based on these calculations, the approach presented here appears to have resolved much of the earlier discrepancy between calculated and measured closures. 56 refs., 22 figs., 2 tabs.

41744 (SKB-TR–88-30) **Rheological properties of sodium smectite clay.** Boergesson, L.; Hoekmark, H.; Karnland, O. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Dec 1988. 67p. Order Number DE89796490/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The rheological properties of Na-smectite Mx-80 have been investigated by various laboratory tests. The investigations include determination of the hydraulic conductivity, the undrained stress-strain-strength properties, the creep properties, the compression and swelling properties in drained and undrained conditions and the undrained thermomechanical properties. Measurements have been made at different densities, clay/sand mixtures and pore water compositions. The influence of temperature, rate of strain and testing technique has also been considered. The investigation has led to a supply of basic data for the material models which will be used at performance calculations. The results have also increased the general understanding of the function of smectitic clay as buffer material. The microstructural behaviour has been considered at the validation of the different test results and the validity of the effective stress theory has been discussed. Comparisons with the properties of Ca-smectite have also been made. (orig.).

41745 (SKB-TR–89-02) **Description of background data in the SKB database GEOTAB.** Eriksson, E.; Sehlstedt, S. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Feb 1989. 61p. Order Number DE89912025/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

During the research and development program performed by SKB for the final disposal of spent nuclear fuel, a large quantity of geoscientific data was collected. Most of this data was stored in a database called GEOTAB. This report describes data within the background data group. This data provides information on the location of areas studied, borehole positions and also some drilling information. The background data group (subject), called BGR, is divided into several subgroups (methods): BGAREA area background data; BGDRILL drilling information; BGDRILLP drill penetration data; BGHOLE borehole information; BGTABLES number of rows in a table, and BGTOLR data table tolerance. A method consists of one or several data tables. In each chapter a method and its data tables are described. (orig./HP).

41746 (WHC-EP–0041) **PORFLO-3: A mathematical model for fluid flow, heat, and mass transport in variably saturated geologic media: Users manual, Version 1.0.** Runchal, A.K.; Sagar, B. Westinghouse Hanford Co., Richland, WA (USA). Jul 1989. 215p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC06-87RL10930. Order Number DE89013977/JAW. Available from NTIS, PC A10/MF A01 - OSTI.

This manual provides instructions for the use of the PORFLO-3 computer code. This computer code is based on mathematical formulation of fluid flow, heat transfer, and mass transport in variably saturated geologic media. The geologic medium may be heterogeneous and anisotropic and may contain linear and planar features such as boreholes and fractures. The code can be used to analyze three-dimensional problems of partially as well as fully saturated media with various types of fluid, heat, and mass sources. PORFLO-3 is written in American National Standard Fortran 77. A summary of the theory of PORFLO-3 is provided in Chapter 2.0. The three partial differential equations that govern fluid flow, heat, transfer, and mass transport and the method of their solution are discussed. The governing equations are discretized by the method of 'Nodal Point Integration' and solved by any of the four alternate methods: Point-successive Over-relaxation, Alternating Direction Implicit Scheme, Choleski Decomposition, and Gaussian Elimination. The structure of the code and the information flow between its 89 subroutines are explained in Chapter 3.0. Certain practical suggestions for the design of the spatial grid and choice of time steps are discussed in Chapter 4.0. A format-free approach for data input is used in PORFLO-3. This aspect is discussed in Chapter 5.0 and in Appendix A. Chapter 6.0 provides detailed instructions for data input. Input and output for two example problems are shown in Appendix B. Error messages from PORFLO-3 are listed in Appendix C.

41747 (WHC-EP–0267) **Westinghouse Hanford Company effluent report for 300, 400, and 1100 Area operations for calendar year 1988.** McCarthy, M.J. Westinghouse Hanford Co., Richland, WA (USA). Jul 1989. 13p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930. Order Number DE89016122/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report tabulates both radioactive and nonradioactive liquid and airborne effluent data for 300, 400, and 1100 Area operations at the Hanford Site. The 300 Area is primarily a research and development area. The 400 Area houses the Fast Flux Test Facility. The 1100 Area contains central stores and vehicle maintenance facilities. Releases to the environment from Westinghouse Hanford Company operations within these areas during calendar year 1988 were both consistent with previous years and within regulatory limits. 2 refs., 8 tabs.

41748 (WHC-MR–0034) **Status of ground water in the 1100 area.** Law, A.G. Westinghouse Hanford Co., Richland, WA (USA). Jul 1989. 25p. Sponsored by U.S. DOE Environment Health

& Safety. DOE Contract AC06-87RL10930. Order Number DE89016119/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The ground water in the 1100 Area is monitored as a precautionary measure since the City of Richland's recharge and well field site is downgradient from the US Department of Energy (DOE) past practice, non-radioactive disposal sites. It is believed that there is insufficient driving force to move contaminants down to the water table, and modeling suggests that the well field is operated in such a manner that movement into the well field is unlikely. Monitoring of five wells installed in late 1988 is being conducted to provide additional assurance on the safety of the ground water for use by residents of Richland. The three wells near the well field are sampled monthly and analyses are performed for several constituents deemed to be indicative of potential contaminants from DOE facilities. All five wells are sampled quarterly with analyses conducted for a lengthy list of constituents. Results of the analyses indicate that the ground water meets drinking water standards. The first attachment is a map of the 1100 area showing the location of the five new wells. Attached is a listing of the analytical results from the monthly sampling of the three wells near the well field. Attached is a listing of all results for routine monitoring of the wells since the work was initiated in November 1988. This listing contains the detection limit and the drinking water standard or maximum contaminant level, where appropriate, of each constituent.

41749 (WHC-SA–0508) **Teaching corporate culture using interactive video training.** Gardner, P.R. Idaho National Engineering Lab., Idaho Falls, ID (USA). Feb 1989. 8p. DOE Contract AC06-87RL10930. (CONF-890279–1: 7. conference on interactive instruction delivery, Kissimmee, FL, US, February 22, 1989). Order Number DE89008049/JAW. Available from NTIS, PC A02/MF A01.

The Westinghouse Hanford Company (Westinghouse Hanford) Total Qualtiy Program includes development of an Interactive Video (IV) course, Hanford General Employee Training (HGET). The commitment to Total Quality is developed in both new and requalifying employees by requiring them to make positive choices when confronted with real life scenarios showing violations of safety, security, and quality standards. This courseware is different from most HGET courses because it puts the trainee in a role-playing mode and requires the trainee to recognize and respond "in the Westinghouse Hanford way." 7 refs.

41750 **Colloid formation study of U, Th, Ra, Pb, Po, Sr, Rb, and Cs in briny (high ionic strength) groundwaters.** Maiti, T.C. (9512268); Smith, M.R.; Laul, J.C. *Nuclear Technology (USA),* 84(1): 82-87 (Jan 1989).

Colloid formation of uranium, thorium, radium, lead, polonium, strontium, rubidium, and cesium in briny (high ionic strength) groundwaters is studied to predict their capability as vectors for transporting radionuclides. This knowledge is essential in developing models to infer the transport of radionuclides from the source region to the surrounding environment. Except polonium, based on the experimental results, colloid formation of uranium, thorium, radium, lead, strontium, rubidium, and cesium is unlikely in brines with compositions similar to the synthetic Palo Duro Basin brine. This observation of no colloid formation is explained by electrokinetic theory and inorganic solution chemistry.

41751 **Inconsistencies in thermodynamic analyses of long-term isolation of high-level waste.** Schweitzer, D.G. (9504782). *Nuclear Technology (USA),* 84(1): 88-92 (Jan 1989).

Important thermodynamic analyses of possible reactions affecting the long-term performance of the engineered materials being considered for isolation of high-level waste are reviewed. Analysis of the literature on the possible failure mechanisms of copper waste packages in granite and basalt environments shows that many of the conclusions from postulated thermodynamic equilibria reactions are inconsistent with the original assumptions and with observations. The absence of evidence for the existence of reactions calculated to have negative free energy changes is classically explained by kinetic inhibitions.

41752 **Dry rod consolidation technology at the Idaho National Engineering Laboratory.** Fisher, M.W.; Mullen, C.K.; Feldman, E.M. *Transactions of the American Nuclear Society (USA),* 57: 322-324 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

The Nuclear Waste Policy Act of 1982 assigned the US Department of Energy (DOE) the task of assisting utilities with resolution of their near-term spent-fuel storage problems. EG & G Idaho, Inc., under contract with DOE, at the Idaho national Engineering Laboratory (INEL), has performed dry horizontal consolidation of fuel rods from 48 Westinghouse 15 x 15 array pressurized water reactor (PWR) fuel assemblies. Project objectives were to design, fabricate, test, and operate a nonproduction type machine to perform dry horizontal consolidation of fuel rods from 48 spent PWR fuel assemblies. Other objectives were to document information on the conditions and characteristics of the fuel and fuel assemblies and the consolidation process. This paper presents an overview of the project and major results and information obtained by the dry rod consolidation technology (DRCT) project.

41753 **Westinghouse fuel consolidation process evolution.** Bassler, E.A. *Transactions of the American Nuclear Society (USA),* 57: 325-326 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

Production rates for fuel consolidation services offered by Westinghouse in the early 1980s were quoted at four assemblies per day, based on the automated equipment system and full bundle pulling concept envisioned at that time. Results from the recent consolidation campaign conducted at Prairie Island indicate that such production rates are still currently achievable, with a simpler approach than in the earlier concepts. With an equipment system comprised of only one assembly unloading station, with its attendant transition canister, feeding into one storage can loading station, a peak production rate of 2.3 assemblies per day was achieved at Prairie Island. Improvement studies since then show that output with this equipment can be increased easily to the desired 4 assemblies per day with the addition of a second unloading station to feed the can loading station and incorporation of refinements identified from the first Prairie Island campaign.

41754 **Adapting French HLW technology to provide complete fuel consolidation services.** Hutchison, C.A.; Matheson, J.E.; Saverot, P.M. *Transactions of the American Nuclear Society (USA),* 57: 326-327 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

Fuel consolidation consists of dismantling the fuel assembly and rear-ranging the spent-fuel rods into a close-packed geometry in a storage canister. Disassembly of the spent fuel in the reactor pool, followed by insertion of the resulting fuel rods in a steel canister having cross-sectional dimensions the same as the original fuel assembly offers the possibility of nearly doubling the spent-fuel pool storage capacity. The Babcock & Wilcox Fuel Company (BWFC) teamed with Numatec, the US-based subsidiary of France's SGN, is developing consolidation equipment called the Fuel Master consolidation system for US nuclear power plants. The Fuel Master features a dual rod transfer system (as a rod is pulled from one spent-fuel assembly, another rod is directly loaded into the storage canister) to provide a significant advantage over intermediate transfer devices. The Fuel Master also features an integrated shear station to deal with the lower end fitting, the assembly skeleton, and the guide tubes. Construction of the Fuel Master equipment is under way. After assembly and checkout in late 1988, cold demonstrations followed by hot demonstrations of the equipment are anticipated shortly thereafter.

41755 **Processing, packaging, and storage of non-fuel-bearing components from the rod consolidation demonstration at Prairie Island Nuclear Generating Station.** McCarten, L.; Kapitz, J.; Kaczmarsky, M.; Rec, J. *Transactions of the American Nuclear Society (USA),* 57: 326-327 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

Many nuclear power plants are running out of space in their spent-fuel pools, and by the early 1990s, existing spent-fuel storage capacity must be supplemented at over 20 commercial nuclear plants. Rod consolidation and dry storage, either individually or in

combination, are the only viable alternatives to meet the spent-fuel storage requirements until a government storage facility or repository is established. The Prairie Island Nuclear Generating Station operated by Northern States Power Company (NSP) is in this predicament. To meet Prairie Island's storage needs, NSP is evaluating the feasibility of full-scale implementation of spent-fuel consolidation. The technical and economic success of fuel consolidation requires successful and economical processing, storage and disposal of the scrap non-fuel-bearing components (NFBC). In the fall of 1987, NSP initiated a consolidation demonstration program at Prairie Island, during which 29 equipment spent-fuel assemblies were successfully consolidated by Westinghouse. The paper discusses program scope, NFBC characterization and classification, NFBC processing and NFBC segregation and packaging.

41756 Spent-fuel skeleton volume reduction - an integral element in an LWR spent-fuel volume reduction system. Larson, H.J.; Trejo, F.; Rudolph, P.; Betancourt, G. *Transactions of the American Nuclear Society (USA)*, 57: 327-328 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

Nuclear Energy Services (NES), in conjunction with Northeast Utilities (NU) has embarked on a spent-fuel skeleton compaction program. Utilizing a mechanical press/shear (P/S) designed and fabricated by NES, volume reduction ratios (V/R) on the order of 10:1 have been obtained. The equipment was originally designed and fabricated by NES for use in its utility fuel pool cleanup (FPCU) projects. This project started over 3 yr ago and has been refined by demonstrations to many potential utility users. The P/S is an intimate part of the overall NES FPCU systems approach. Its end product is a section of compressed material (up to 5 ft long) that is removed from the P/S and is then placed into a properly designed liner for insertion into the NES 5 shipping cask licensed by the US Nuclear Regulatory Commission. Attainment of the objective V/Rs as a result of this development work has resulted in assurance that a cost-effective fuel rod consolidation program is not only possible but can be constructed to realize a system with today's technology that is easily the most cost-effective of any other real-time current spent-fuel disposition alternative.

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Refer also to citation(s) 41693, 41701, 41702, 41704, 41706, 41707, 41708, 41709, 41710, 41733, 41740, 41741, 41742, 41743, 41746, 41747, 41748, 41749, 41750, 41760, 41761, 41767, 42916, 43441, 43488, 43548

41757 (DOE-RW–88.127) **Assessment of artificial radionuclide transfer from Sellafield to South West Scotland.** Baxter, M.S.; Cook, G.T.; McDonald, P. Department of the Environment, London (UK). Mar 1989. 99p. Order Number DE89635265/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

This research extends the data base, on dispersion of Sellafield-derived radionuclides, to the northern Solway coastal zone. Results of a 10km x 10km grid soil survey indicate that the predominant source of $^{239+240}$Pu to the area has been weapons fallout, Chernobyl fallout having greatly modified ^{134}Cs and ^{137}Cs inventories. Inland transects reveal little evidence of airborne sea-to-land transfer of nuclides but riverine systems exhibit regions of significant on-land input from Sellafield via tidal inundation and deposition of particles. Analyses of Irish Sea sediments support the view that northwards transport of nuclides occurs dominantly by particle migration, while sequential leaching suggests a change in chemical association of plutonium between marine and terrestrial systems. Hot particles were detected in several intertidal sediments. In radiological terms, airborne on-land transfer of Sellafield radionuclides is generally of negligible significance. Nuclide inventories in Solway soils are generally well below the limiting values implied by the recommended Generalised Derived Limits. In some tidally inundated riverbank areas however, ^{137}Cs, Puα and ^{241}Am levels occasionally exceed 25% of the appropriate GDL values. The data base reported here should be useful in extending mathematical models of Sellafield nuclide dispersion. (Author).

41758 (EPS–2/MM/1) **Assessment of the radiological impact of uranium mining in northern Saskatchewan.** Environment Canada, Ottawa, ON (Canada). Environmental Protection Service; Atomic Energy Control Board, Ottawa, ON (Canada); IEC Beak Consultants Ltd., Mississauga, ON (Canada). Jun 1986. 194p. Order Number DE89635266/JAW. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

This report presents the findings of a study which investigated the regional radiological impact of uranium mining in northern Saskatchewan. The study was performed by IEC Beak Consultants Ltd. under a contract awarded by Environment Canada in partnership with the Atomic Energy Control Board. This preliminary assessment suggests there is a negligible combined regional radiological impact from simultaneous operation of the three operating mines investigated as part of the present study. The mines are spaced too far apart for any superposition of emissions to be significantly greater than a small fraction of background levels. The most exposed individual not directly associated with any of the mining operations is estimated to receive a total radiation dose equal to about 3% of the dose due to natural background radiations. This increment is equivalent to the increment in natural background that would be received by an individual moving from Vancouver to Wollaston Post, before mining began in the area, as a result of reduced atmospheric shielding from cosmic radiation. Radiological impacts on biota are estimated to have insignficant effects on natural populations in all cases. However, since the study only investigates the effects of operational releases of radionuclides, the results do not imply that uranium mining developments will or will not have significant long-term radiological impact on northern Saskatchewan. Radiological impact assessments described in this report are estimates only. There are some uncertainties in the available data and modelling methodology. The radiological impact of abandoned tailings areas was not included in this study.

41759 (ORNL/FTR–3335) **[Design of nuclear fuel reprocessing plants, Neuherberg, Munich, Hannover and Wackersdorf, FRG, July 5–19, 1989]: Foreign trip report.** Fields, D.E. Oak Ridge National Lab., TN (USA). 24 Jul 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015370/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The proposed fuel reprocessing site was characterized as to meteorological and hydrological characteristics and population geographical distribution. Data were gathered characterizing the fuel reprocessing plant licensing procedure currently used in the FRG. Comparisons were made of fuel reprocessing in the FRG, France, and Great Britain.

0540 Health and Safety

Refer also to citation(s) 41736, 42153

41760 (DOE/GJ/01621–T1) **Grand Junction Remedial Action Program: Final report.** Colorado State Government, Denver, CO (USA). May 1989. 197p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract FC07-73GJ01621. Order Number DE89016092/JAW. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

The Grand Junction Remedial Action Program (hereinafter referred to as the Program) originated in 1972 due to a recognized need to reduce the levels of radiation found in some of the structures identified in Grand Junction, Colorado that were constructed in part with uranium mill tailings. Out of over 640 locations eventually identified as qualifying for corrective action, the Program performed remedial construction on 594 of them. The owners of over 45 unremediated structures either did not wish to participate in the voluntary Program, or the structures were torn down, burned down, or were abandoned before the Program could take action on them. Because this was the first remedial action program of its type, and because its task was to reduce the radiation levels as soon as practical, there was no time for lengthly research and development of remedial methods or techniques. Trial and error combined with basic engineering and health physics produced a Program that learned as it progressed. At a cost of $22.7 million over a 15-year period, a substantial portion of the community had radiation exposure reduced because many public buildings such as schools,

churches, and businesses, as well as private residences were remediated. 21 refs., 10 figs., 6 tabs.

41761 (DOE/HWP–79) **Hazardous Waste Remedial Actions Program: Remedial Actions Planning Program Quality Assurance Program Plan.** Oak Ridge National Lab., TN (USA). Hazwrap Support Contractor Office. Apr 1989. 25p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. (HZ/RAP–102). Order Number DE89016331/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The purpose of this Plan is to describe the quality assurance (QA) requirements for the RAP Program by identifying the quality elements to be controlled and specifying how they will be controlled. The activities for which control elements will be identified include those relating to: preparation, review, and approval of plans, reports, and studies; execution of field and analytical work by subcontractors and other agents; control of subcontractors and other agents during other phases of work; and actions internal to the RAP Program to ensure proper execution of projects.

41762 (DOE/OR/21548–061-Rev.0) **Chemical soil investigation report for the Weldon Spring Chemical Plant/Raffinate Pits, Phase II.** MK-Ferguson Co., St. Charles, MO (USA); Jacobs Engineering Group, Inc., St. Charles, MO (USA). Aug 1989. 109p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-86OR21548. Order Number DE89016206/JAW. Available from NTIS, PC A06/MF A01 - OSTI.

This report presents data and interpretations from the Phase II Chemical Soil Investigation at the Weldon Spring Chemical Plant/ Raffinate Pits. This investigation was performed to provide data in support of the Remedial Investigation and Baseline Risk Assessment. The investigation consisted of both biased and unbiased sampling programs designed to detect contamination from previous operations. Very small amounts of nitroaromatic compound contamination were detected in former ordnance production areas. Metals and inorganic anion contamination was observed in numerous locations related to both explosives and uranium production. Small amounts of semi-volatile organic, pesticide, and PCB contamination were also detected. No volatile organic contamination was observed. The data collected in this investigation was of sufficient quality and quantity to characterize the on-site chemical soil contamination. Additional investigations may be required to support remedial design. 14 refs., 3 figs., 8 tabs.

41763 (DOE/OR/21548–092-Rev.0) **Waste assessment chemical characterization of the Weldon Spring site Raffinate Pitts.** MK-Ferguson Co., St. Charles, MO (USA). Aug 1989. 163p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-86OR21548. Order Number DE89016201/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

As part of the remedial investigation efforts conducted at the Weldon Spring Site Remedial Action project (WSSRAP), it was recognized that an assessment of the nature and extent of the types of waste in the Weldon Spring Raffinate Pits (WSRP) was necessary to evaluate treatment and disposal alternatives. A sampling plan was developed, therefore, which detailed sample locations, sample parameters, and sampling techniques. The sampling effort consisted of collecting 145 samples from 42 locations. The sampling locations were evenly distributed across each of the four raffinate pits in terms of both area and depth. The samples were analyzed for nitroaromatics, metals, inorganic anions, volatiles, semi-volatiles, PCBs/ pesticides, oil and grease, total organic halogens, total organic carbon, cyanides and phenols. The data were then evaluated specific to each pit. At a later date the surface waters of each pit were sampled and similarly analyzed for metals. Samples were also analyzed for radiological contaminants. Information regarding radiological characterization is available in a companion report. 5 figs., 24 tabs.

41764 (INIS-mf–11483, pp. 3) **Remarks on some problems of radiation protection concerning low-active materials in nuclear power plants with PWR.** Eschner, G. (VEB Kombinat Kraftwerksanlagenbau, Berlin (German Democratic Republic)). Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

41765 (INIS-mf–11483, pp. 12-13) **Radiation protection on a krypton 85 enrichment device.** Schulze, H.W. (Akademie der Wissenschaften der DDR, Leipzig (German Democratic Republic). Zentralinstitut fuer Isotopen- und Strahlenforschung). Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

41766 (INIS-mf–11483, pp. 3-4) **Radiation protection and dosimetric investigations in space flights.** Dudkin, V.E. (Institute of Biomedical Problems, Moscow (USSR)); Marenny, A.M. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

41767 (WHC-EP–0246) **Base calibration of Pacific Northwest Laboratory's gross gamma borehole geophysical logging system.** Brodeur, J.R.; Koizumi, C.J. Westinghouse Hanford Co., Richland, WA (USA). Jun 1989. 87p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC06-87RL10930. Order Number DE89015400/JAW. Available from NTIS, PC A05/MF A01 - OSTI.

This report describes a base calibration of Pacific Northwest Laboratory's gross gamma geophysical logging system. The calibration was conducted to permit the use of this system for geologic and hydrologic studies associated with remedial investigation at the Hanford Site and to determine the suitability of the instrumentation for monitoring in areas with radiological contamination. A basic description of the system instrumentation is provided. A calibration check of this instrumentation measured linearity, dead-time, and instrument drift. A primary calibration to equivalent uranium units was conducted in Spokane, Washington, at a US Department of Energy field calibration facility. This primary calibration was only partially successful because the system could not measure the activity in a calibration model zone containing a high uranium concentration. The primary calibration was therefore limited to system response in a zone with low uranium concentration. It is therefore impossible to determine the linearity of the conversion to equivalent uranium units with this system. 7 refs.

41768 Impact of groundwater protection standards on UMTRA Project. Matthews, M.L. (U.S. Dept. of Energy, Albuquerque, NM (US)); Lechel, D.J. vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

In September 1987, the U.S. Environmental Protection Agency (EPA) proposed health and environmental standards to correct and prevent groundwater contamination beneath and in the vicinity of the Uranium Mill Tailings Remedial Action (UMTRA) Project sites. The standards, which are consistent with the Resource Conservation and Recovery Act (RCRA), address final disposal, aquifer cleanup, and supplemental standards. As a first step toward estimating the total project groundwater restoration costs, the conditions, requirements, and aquifer restoration costs at five sites were considered: Gunnison, Colorado; Riverton, Wyoming; Lakeview, Oregon; Tuba City, Arizona; and Falls City, Texas. For each site, preliminary groundwater restoration schemes were proposed and evaluated, and base costs were estimated in 1988 dollars. To forecast total project costs, the five site-specific evaluations and their lowest cost estimates were extrapolated to the remaining 19 UMTRA Project sites. To estimate a total program cost based on the lowest site remedial action construction costs described above, the ratio of total program cost to the site remedial action costs for the current UMTRA Project was

calculated. On the basis of the preliminary analyses described above, if aquifer restoration were required at the 24 UMTRA Project sites, the total program cost may be in excess of /1 billion.

41769 RM-10A robotic manipulator system. White, J.R.; Coughlan, J.B.; Harvey, H.W.; Upton, R.G. *Transactions of the American Nuclear Society (USA),* 57: 335-336 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

The REMOTE RM-10A is a man-replacement manipulator system that has been developed specifically for use in radioactive and other hazardous environments. It can be teleoperated, with man-in-the-loop, for unstructured tasks or programmed to perform routine tasks automatically much like robots in the automated manufacturing industry. The RM-10A is a servomanipulator utilizing a closed-loop, microprocessor-based control system. The system consists of a slave assembly, master control station, and interconnecting cabling. The slave assembly is the part of the system that enters the hostile environment. It is man-like is size and configuration with two identical arms attached to a torso structure. Each arm attaches to the torso using two captive screws and two guide pins. The guide pins position and stabilize an arm during removal and reinstallation and also align the two electrical connectors located in the arm support plate and torso. These features allow easy remote replacement of an arm, and commonality of the arms allow interchangeability. The water-resistant slave assembly is equipped with gaskets and O-ring seals in the torso and arm and camera assemblies. In addition, each slave arm's elbow, wrist, and tong are protected by replaceable polyurethane boots. An upper camera assembly, consisting of a color television (TV) camera, 6:1 zoom lens, and a pan/tilt unit, mount to the torso to provide remote viewing capability.

0550 Safeguards, Inspection, and Accountability

Refer also to citation(s) 41768, 42636

41770 (DOE/SSDP–0078) **Decision process involved in preparing the Shippingport reactor pressure vessel for transport.** Murphie, W.E. Westinghouse Hanford Co., Richland, WA (USA); USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1989. 4p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930;AC06-84RL10421. (CONF-890736–51: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL (USA), 9-12 Jul 1989). Order Number DE89015890/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The most significant part of the Shippingport Station Decommissioning Project was the one-piece removal and shipment of the reactor pressure vessel (RPV). Implicit in the RPV transport was the task of qualifying the RPV as a waste package acceptable for shipment. Soon after physical decommissioning began on September 1985, questions regarding the packaging certification and transport of the RPV from Shippingport, Pennsylvania to the US Department of Energy (DOE) Hanford Waste Burial Site necessitated reexamination of several planning assumptions. A complete reassessment of the regulatory requirements governing the RPV shipment resulted in a programmatic decision to obtain a type B(U) Certificate of Compliance and abandon the originally planned US Department of Transportation (DOT) low specific activity (LSA) shipment. The decision process resulting in this conclusion was extensive and involved many organizations and agencies. Incidental to this process, several subtle certification issues were identified that required resolution. Some of these issues involved the definition of LSA material for large packages; interpretation and compliance with DOE, DOT and US Nuclear Regulatory Commission (NRC) regulations for the transport of radioactive material; incorporation of the International Atomic Energy Agency (IAEA) regulations by the Panama Canal; and DOE policy requiring advance notification to states of radioactive waste shipments. 2 figs.

41771 (INIS-mf–11495, pp. 46-47) **Universal go-nogo monitor.** Baxter, P. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)); Boldeman, J.W. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The holders of gas centrifuge enrichment technology have negotiated the Hexapartite Agreement to satisfy the need for credible safeguards arrangements at commercial enrichment plants. A central component of this agreement is the concept of limited frequency unannounced access to the cascade halls of the plants. To put this concept into effect there is a need for a non intrusive instrument that could verify that only low enriched uranium (<20%) was passing through the various size pipework of the cascades. Instruments developed to date have been plant specific in that measurements could be carried out on only one pipe size. These instruments have been given the generic title of Go-NoGo Monitors. The Universal Go-NoGo Monitor described in this paper is capable of obtaining measurements on pipes ranging in size from 32 mm to 120 mm.

41772 (INIS-mf–11989, pp. 223) **New trends in safeguards measurement technology.** Hakkila, E.A. (Los Alamos National Lab., NM (USA)). Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

41773 (INIS-mf–11989, pp. 223) **Needs and characterisation of standards for nondestructive assay in safeguards.** Guardini, S. (Commission of the European Communities, Ispra (Italy). Inst. for Safety Technology); Guzzi, G.; Mousty, F. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

41774 (KFK–4476, pp. 319-338) **NRTA methods in the framework of nuclear safeguards.** Beedgen, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Datenverarbeitung in der Technik). Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

Three statistical test methods for the NRTA process (Near Real Time Accountancy) for drawing up a sequential, near real time accounting for fissile material are briefly described: (a) the CUMUF test (= Cumulative Material Unaccounted For); (b) the GEMUF test based on an important result of the statistical theory: the lemma by Neyman and Pearson; (c) the Page test frequently used for quality control. For the evaluation of the sequential accounting data the computer program PROSA was developed. With the aid of Monte Carlo simulations and on the basis of false alarm probabilities and a statistical system measuring model for the material to be accounted for it determines whether or not an alarm has occurred in one of the three tests and in which accounting period. The results of the evaluation are presented in graphical representations. (RB).

41775 (LA-UR–89-2534) **Materials accounting and international safeguards for MOX facilities.** Pillay, K.K.S.; Picard, R.R.; Hafer, J.F. Los Alamos National Lab., NM (USA). 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890736–54: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL (USA), 9-12 Jul 1989). Order Number DE89015290/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Our experience with mixed oxide (MOX) fuel fabrication facilities leads us to conclude that there is inadequate guidance available to plant and process designers to make materials accounting systems timely, efficient, and minimally intrusive. A well designed state system for accounting and control of nuclear materials would be beneficial to plant operations and verification by the International Atomic Energy Agency (IAEA) or state regulatory agencies. Among the difficult accounting problems that arise in a large-scale MOX facility are the following: (1) process steps (such as the blending and splitting of powders) that require the accounting system to track material flow, calculate quantities based on previous measurements, and propagate uncertainties as part of data analysis; (2) extensive buffer storage areas involving long residence times that necessitate frequent corrections for material loss from radioactive decay; and (3) facility accounting at one level (for example, fuel pins) that must be reconciled with verification measurements at another level (for example, pin trays or assemblies). Approaches to addressing these problems include designing a special facility, simulating material flow, developing software for near-real-time materials accounting, and establishing achievable verification goals. This paper elaborates on these problems and proposes approaches to a materials accounting system design that considers facility, state, and IAEA safeguards and verification objectives. 11 refs., 1 fig., 1 tab.

41776 (NUREG–0525-Rev.15) **Safeguards summary event list (SSEL): Pre-NRC through December 31, 1988.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards and Transportation. Jul 1989. 266p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A12/MF A01 - GPO - OSTI.

The Safeguards Summary Event List (SSEL) provides brief summaries of several hundred safeguards-related events involving nuclear material or facilities regulated by the US Nuclear Regulatory Commission (NRC). Because of public interest, also included are events reported involving byproduct material which is exempt from safeguards requirements. Events are described under the categories of bomb-related, intrusion, missing and/or allegedly stolen, transportation, tampering/vandalism, arson, firearms, radiological sabotage, nonradiological sabotage, alcohol and drugs, and miscellaneous. The information contained in the event descriptions is derived primarily from official NRC reporting channels.

41777 (WHC-EP–0274) **Balanced magnetic switch selection, installation, and operation guide.** Curry, R.H.; Bentley, B.B. Westinghouse Hanford Co., Richland, WA (USA). Jul 1989. 18p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE89015401/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Westinghouse Hanford Company prepared this document in response to Safeguards and Security support tasks assigned under its contract with the US Department of Energy, Richland Operations Office. The document provides general information on security system components known as balanced magnetic switches. The information comprises a guide for use by security personnel at US Department of Energy field sites around the country. The guide aids in the selection, installation, and maintenance of balanced magnetic switches. 6 refs.

0560 Legislation and Regulations

41778 (INIS-mf–11507) **Deep geological disposal of nuclear fuel waste: background information and regulatory requirements regarding the concept assessment phase. Regulatory policy statement.** Atomic Energy Control Board, Ottawa, ON (Canada). Jan 1985. 38p. (In English, French). Order Number DE89635650/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

French version included. Regulatory Document R-71.

In their Joint Statement of August 1981, the governments of Canada and Ontario noted that the Nuclear Fuel Waste Program had been established to assure the safe and permanent disposal of radioactive waste from nuclear power reactors. The statement addressed the scope and schedule of the 'Concept Assessment Phase' of the Program, and identified the participating organizations and their responsibilities. The scope of this initial phase includes the development and assessment by Ontario Hydro and Atomic Energy of Canada Limited (AECL) of a disposal concept and its subsequent review by the regulatory agencies and government. The Atomic Energy Control Board (AECB), as lead regulatory agency is issuing this statement to outline its position with respect to evaluation of the concept.

41779 (INIS-mf–11509) **Bioassay requirements for ^{125}I and ^{131}I in medical, teaching and research institutions. Regulatory guide.** Atomic Energy Control Board, Ottawa, ON (Canada). Sep 1983. 40p. (In English, French). Order Number DE89635646/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

French version included. Regulatory Document R-58.

The more widespread use of radioactive isotopes of iodine (collectively referred to as radioiodines) as a research tool, coupled with their diagnostic and therapeutic uses in nuclear medicine, has resulted in an increased number of personnel who are exposed to these radioisotopes and who therefore should be monitored for internal radioiodine contamination. This document describes the minimum acceptable features of a bioassay programme which the Atomic Energy Control Board (AECB) requires to be available in institutions holding a prescribed substance licence authorising the use of significant quantities of ^{125}I or ^{131}I or both. A licensee may submit details of his own proposed bioassay programme to the AECB for approval. If such a programme fails to be approved, the programme described below shall be adhered to. This document does not deal with individuals who are likely to maintain a significant chronic thyroid burden of radioiodine. It is assumed that the radioiodine taken into the body is in a soluble, inorganic form (I_2, iodide or iodate) or in an organic form (e.g. methyl iodide) which is metabolised in the body with a resultant release of iodide. Radioiodinated organic compounds which are not catabolised to iodide in the body to any significant degree are not the subject of this document, since the metabolism of the radioiodine will be dictated by the metabolism of the compound. This means that individuals whose only exposure to radioiodine is in the form of prepared radioiodinated compounds such as antigens and antibodies (e.g. individuals using radio immuno assay kits in which the antigen or antibody is supplied as radioiodinated material) are not required to participate in this bioassay programme for radioiodine.

41780 (ORNL/FTR–3339) **[International Atomic Energy Agency's technical committee meeting on the continuous review of the IAEA's regulations for the safe transport of radioactive material, Vienna, Austria, July 10-14, 1989]: Foreign trip report.** Pope, R.B. Oak Ridge National Lab., TN (USA). 28 Jul 1989. 78p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC05-84OR21400. Order Number DE89016456/JAW. Available from NTIS, PC A04/MF A01 - OSTI.

The traveler participated in the Technical Committee on the Continuous Review of the IAEA's Regulations for the Safe Transport of Radioactive Material and the Supporting Documents, where the traveler was the US's representative on one of three working groups, served as co-secretary for that working group, and also presented and defended a paper documenting the results of a previous consultants committee. Recommendations were made concerning either accepting them as minor changes or changes of detail (the latter requiring IAEA Member State approving votes) to the 1985 Edition of the IAEA's Regulations, or as Major Changes or Identified Problems needing further consideration in anticipation of the 1995 revision of the Regulations. All items submitted were considered. A total of 31 minor changes and 8 changes of detail were recommended. Approximately 35 items were identified for further study; the remaining items were rejected.

41781 Greater-than-Class-C low-level radioactive waste management concepts. Knecht, M.A. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID (US)). vp. of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ (USA), 28 Feb - 3 mar 1988).

In 1986, Public Law 99-240, the Low-Level Radioactive Waste Policy Amendments Act of 1985 assigned to the Federal Government responsibility for the disposal of commercial greater-than-Class-C (GTCC) low-level radioactive waste (LLW). In 1987, DOE committed to Congress to accept GTCC LLW and provide

storage and other waste management as necessary until disposal capacity is available. Current estimates are that about 6,000 m^3 of unpackaged GTCC LLW will be generated to the year 2020. Generators estimate that 100 m^3 of raw GTCC LLW might exceed planned storage capacity to the year 2020. This paper reports the activities of the National Low-Level Waste Program to manage GTCC low-level radioactive waste.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

41782 (CFFTP-G–87011) **Separation of hydrogen isotopes by a flowing bed process.** Singh, V.P. Canadian Fusion Fuels Technology Project, Toronto, ON (Canada). Mar 1987. 47p. Order Number DE89635397/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Results of an experimental study on a flowing bed process for continuous hydrogen isotope separation are presented. Separation performance was low with a 25% by weight palladium on alumina adsorbent, resulting in a high tritium inventory. In addition, significant breakdown of the solid adsorbent occurred as it recirculated through the process equipment and the product streams were contaminated by the adsorbent carrier gas. Due to these problems, this flowing bed process is predicted to be uneconomic for a full scale plant.

41783 (GSI–89-42(prepr.)) **Electromagnetic isotope enrichment for accelerator mass spectrometry of ^{41}Ca.** Steinhof, A.; Behr, K.H.; Bruenle, A.; Roeckl, E.; Boaretto, E.; Paul, M.; Fink, D.; Hollos, G.; Kutschera, W. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.). May 1989. 11p. Contract W-31-109-ENG-38. Available from Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.).

A procedure to enrich the natural ^{41}Ca abundance in calcium by variable amounts was developed at the GSI medium-current mass separator. The method was applied to increase the natural ^{41}Ca/Ca ratios in three samples of modern deer bone, which were subsequently measured by accelerator mass spectrometry at the Rehovot 14 UD Pelletron tandem accelerator. The following enrichment factors and original ^{41}Ca/Ca ratios were measured for three bone samples, which all originate from approximately the same region in Germany: (i) 24.9 $\pm$ 1.3, (1.8 $\pm$ 0.7)x10^{-14}, (ii) 48.4 $\pm$ 2.4, (2.4 $\pm$ 0.6)x10^{-14}; (iii) 49.3 $\pm$ 2.5, (5.7 $\pm$ 1.1) x 10^{-14}. These ^{41}Ca/Ca ratios lie at the upper end of terrestrial values measured in various bone samples at other laboratories. The measured ratios alltogether spread over two orders of magnitude. (orig.).

41784 (INIS-mf–11503, pp. 11-13) **Use of isotopes in medicine.** Ringler, G. (Soreq Nuclear Research Center, Yavne (Israel). Dept. of Radiopharmaceuticals). Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Summary only.

0702 Radiation Sources

Refer also to citation(s) 41535, 42660, 43561, 43760

41785 (AECL–9065) **Effects of irradiation of sewage sludge on heavy metal bioavailability.** Sheppard, S.C.; Mayoh, K.R. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. Oct 1986. 55p. Order Number DE89635409/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Sewage sludges are a valuable resource to agriculture, but their use is limited by the hazards of pathogens, toxic chemicals and heavy metals. Irradiation can control the pathogens and deactivate some of the toxic chemicals. The relative cost of industrial-scale irradiation using accelerators has decreased progressively. This, coupled with the increasing necessity to recycle wastes, has led to renewed interest in irradiation of sludges. In response to this renewed interest, this report examines what is known about the effects of irradiation on the bioavailability of heavy metals. Very few studies have addressed this topic, although workers in the U.S. have claimed decreased solubility of metals in irradiated sludges. We have also briefly reviewed the general literature on sludge to gain indirect evidence on the likely effects. The scant data, often based on less than ideal experimental methodologies, show no major consistent effects of irradiation on the availability of heavy metals from sludge. The data are not sufficient to rule out such effects entirely, but the effects appear to be fairly subtle and not likely to persist beyond one growth season. 85 refs.

41786 (AECL–9264) **Shielded storage vault for radioactive reference sources.** Spenceley, H.C. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Aug 1986. 11p. Order Number DE89635399/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A new storage vault has been built for radioactive reference sources prepared by and used in the Nuclear Detectors and Metrology Section at Chalk River. Design and construction details are described. Some of the stronger sources are stored in individual shields or shielded drawers to reduce radiation exposure when moving weaker sources. The new vault provides better organization and access as well as reduced radiation exposure compared to the one it replaced.

41787 (INFO–0263) **Ionization chamber smoke detectors. Questions and answers.** Atomic Energy Control Board, Ottawa, ON (Canada). Mar 1988. 24p. (In English, French). Order Number DE89635400/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

French version included.

One kind of smoke detector, the ionization-type, is regulated by the Atomic Energy Control Board (AECB) because it uses a radioactive substance in its mechanism. Radioactivity and radiation are natural phenomena, but they are not very familiar to the average householder. This has led to a number of questions being asked of the AECB. These questions and AECB responses are outlined.

41788 (INIS-mf–11476) **Use of radioisotope tracers in the metallurgical industries.** Easey, J.F. Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia). 1987. 8p. (CONF-8711314–: Seminar on the application of nuclear techniques in industry, 17 Nov 1987). Order Number DE89635413/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI.

Radioisotope techniques have been widely used in the metallurgical industries for many years. They have been shown to be very suitable for studying large scale plant and, in many cases, they are the most suitable techniques for such investigations. Applications of radioisotope tracers to some specific metallurgical problems are discussed. (author).

41789 (INIS-mf–11477) **Radioisotope tracer applications in industry.** Rao, S.M. International Atomic Energy Agency, Vienna (Austria). 1987. 17p. (CONF-8711314–: Seminar on the application of nuclear techniques in industry, 17 Nov 1987). Order Number DE89635414/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI.

Radioisotope tracers have many advantages in industrial troubleshooting and studies on process kinetics. The applications are mainly of two types: one leading to qualitative (Yes or No type) information and the other to quantitative characterisation of flow processes through mass balance considerations and flow models. "Yes or No" type methods are mainly used for leakage and blockage locations in pipelines and in other industrial systems and also for location of water seepage zones in oil wells. Flow measurements in pipelines and mercury inventory in electrolytic cells are good examples of tracer methods using the mass balance approach. Axial dispersion model and Tanks-in-Series model are the two basic flow models commonly used with tracer methods for the characterisation of kinetic processes. Examples include studies on flow processes in sugar crystallisers as well as in a precalcinator in a cement plant. (author). 18 figs.

41790 (INIS-mf–11483, pp. 11) **Express method of protein determination in the plant grain seeds and the products of their conversion with the help of an isotopic source of neutrons 252-Cf.** Nazarov, V.M. (Joint Inst. for Nuclear Research, Dubna (USSR)); Pavlov, S.S.; Ostrovnaja, T.M.; Sisoev, V.P. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

41791 (INIS-mf–11495, pp. 154-156) **Use of radioactive tracers to study metal and slag flow in blast furnaces.** Wiblin, W.A. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The radionuclides ^{198}Au, ^{60}Co, ^{46}Sc and ^{140}La were used as tracers to determine flow characteristics and residence times for the iron and slag phases in an iron blast furnace hearth. This was done by injecting the tracers at various positions around the circumference of the furnace and measuring the induced activity of the iron and slag produced at the taphole.

41792 (INIS-SU–99/A) **Investigation into and application of X-ray fluorescence method for analysis of scheelite ores and their processing products.** Khajdarov, A.A.; Batalov, N.Ya. AN Uzbekskoj SSR, Tashkent (USSR). Inst. Yadernoj Fiziki. 1987. 7p. (In Russian). Order Number DE89635405/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

An X-ray fluorescence method for analysis of scheelite ores and their processing products for WO_3 applied to quality control is described. The analysis was carried out using the most intensive K_α-lines of characteristic tungsten radiation exited in a sample with a Tu-170 source, which β-decay was followed by γ-radiation at $E_1$84 keV, and K-series of ytterbium radiation (E_2=52 keV). The characteristic radiation was detected with scintillation counters based on NaI(Tl) crystal. The method reproducibility was estimated. The comparative evalutions of the given method and chemical analysis are given. The sensitivity is 0,04% WO_3. Preprint R–3-292.4 refs.; 2 tabs.

41793 (LA-UR–89-2591) **LANSCE [Manuel Lujan, Jr. Neutron Scattering Center] target system performance.** Russell, G.J.; Gilmore, J.S.; Robinson, H.; Legate, G.L.; Bridge, A.; Sanchez, R.J.; Brewton, R.J.; Woods, R.; Hughes, H.G. III. Los Alamos National Lab., NM (USA). 1989. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8810182–31: International collaboration on advanced neutron sources (ICANS), 3-7 Oct 1988). Order Number DE89015276/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We measured neutron beam fluxes at LANSCE using gold foil activation techniques. We did an extensive computer simulation of the as-built LANSCE Target/Moderator/Reflector/Shield geometry. We used this mockup in a Monte Carlo calculation to predict LANSCE neutronic performance for comparison with measured results. For neutron beam fluxes at 1 eV, the ratio of measured data to calculated varies from ≈0.6-0.9. The computed 1 eV neutron leakage at the moderator surface is 3.9×10^{10} n/eV-sr-s-μA for LANSCE high-intensity water moderators. The corresponding values for the LANSCE high-resolution water moderator and the liquid hydrogen moderator are 3.3 and 2.9×10^{10}, respectively. LANSCE predicted moderator intensities (per proton) for a tungsten target are essentially the same as ISIS predicted moderator intensities for a depleted uranium target. The calculated LANSCE steady state unperturbed thermal ($E < 0.625$ eV) neutron flux (at 100 μA of 800 MeV-protons) is 2×10^{13} n/cm^2-s. The unique LANSCE split-target/flux-trap-moderator system is performing exceedingly well. The system has operated without a target or moderator change for over three years at nominal proton currents of ≈25 μA of 800-MeV protons. 17 refs., 8 figs., 3 tabs.

41794 (PB–89-168090/XAB) **Standardization of ^{67}Ga by liquid scintillation coincidence counting. Research report.** Simpson, B.R.S.; Meyer, B.R. Council for Scientific and Industrial Research, Pretoria (South Africa). 1987. 25p. (CSIR-RR–599). Available from NTIS, PC EE05/MF E05.

North American Continent sales only.

A solution of ^{67}Ga was standardized using measuring techniques developed previously at the National Physical Research Laboratory. An ampule containing a sample of the solution was sent to the Bureau International des Poids et Measures for comparative measurement. The registration table and a plot based thereon are presented. The intensity of the internal-conversion electrons from the 93-keV excited state was measured as 0.311 plus or minus 0.005.

41795 (PB–89-177877/XAB) **Airborne gamma-radiation snow water-equivalent and soil-moisture measurements and satellite areal extent of snow-cover measurements. A user's guide. Version 3.0.** Carroll, T.; Allen, M. National Weather Service, South Minneapolis, MN (USA). National Remote Sensing Hydrology Program. 1 Nov 1988. 67p. Available from NTIS, PC A04/MF A01.

Also available from Supt. of Docs.

The National Remote Sensing Hydrology Program is managed by the Office of Hydrology and consists of the Airborne Snow Survey Section and the Satellite Hydrology Section. The Airborne Snow Survey Section makes airborne snow water-equivalent and soil-moisture measurements over large areas of the country subject to a severe and chronic snowmelt flooding threat. The User's Guide is intended primarily to provide field hydrologists with some background on the technical and administrative aspects of the National Remote Sensing Hydrology Program. The guide summarizes the techniques and procedures used to make and distribute real-time, operational airborne snow water-equivalent measurements and satellite areal extent of snow-cover measurements made over large areas of the country. The current airborne and satellite databases are summarized, and procedures to access the real-time observations through both AFOS and through a commercial, electronic bulletin board system are given in the appendices.

41796 (RNIIRP–88-2) **Calibration characteristics plotting for beta thickness gages using equivalent measures and transient dependences.** Gazman, D.G.; Kononchuk, V.M.; Mussonov, G.P.; Tsalitis, V.A. Rizhskij Nauchno-Issledovatel'skij Inst., Radioizotopnogo Priborostroeniya, Riga (USSR). 1988. 24p. (In Russian). Order Number DE89635406/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The problems of plotting calibration characteristics of piece-exponential type of radioisotope beta backscattering gages for measuring surface density (thickness), are considered. The decrease of calibration error constituents is shown. The peculiarities of natural and equivalent measures of surface density are described. The application of the iteration least square method with variable weight coefficients to determine calibration characteristics coefficient is given. 5 refs.; 8 figs.; 2 tabs.

0703 Isotopic Power Supplies

41797 (LA–11597-MS) **General-Purpose Heat Source development: Extended series test program large fragment tests.** Cull, T.A. Los Alamos National Lab., NM (USA). Aug 1989. 42p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE89014000/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

General-Purpose Heat Source radioisotope thermoelectric generators (GPHS-RTGs) will provide electric power for the NASA Galileo and European Space Agency Ulysses missions. Each GPHS-RTG comprises two major components: GPHS modules, which provide thermal energy, and a thermoelectric converter, which converts the thermal energy into electric power. Each of the 18 GPHS modules in a GPHS-RTG contains four $^{238}PuO_2$-fueled capsules. LANL conducted a series of safety verification tests on the GPHS-RTG before the scheduled May 1986 launch of the Galileo spacecraft to assess the ability of the GPHS modules to contain the plutonia in potential accident environments. As a result of the Challenger 51-L accident in January 1986, NASA postponed the launch of Galileo; the launch

vehicle was reconfigured and the spacecraft trajectory was modified. These actions prompted NASA to reevaluate potential mission accidents, and an extended series safety test program was initiated. The program included a series of large fragment tests that simulated the collision of solid rocket booster (SRB) fragments, generated in an SRB motor case rupture or resulting from a range safety officer SRB destruct action, with the GPHS-RTG. The tests indicated that fueled clads, inside a converter, will not breach or release fuel after a square (142 cm on a side) SRB fragment impacts flat-on at velocities up to 212 m/s, and that only the leading fueled capsules breach and release fuel after the square SRB fragment impacts the modules, inside the converter, edge-on at 95 m/s. 8 refs., 32 figs., 7 tabs.

08 HYDROGEN

0801 Production

Refer also to citation(s) 42297

41798 (IREQ–7403, pp. 21) **Possible uses of hydrogen manufactured through electrolysis.** Belanger, G. (Inst. de recherche de l'Hydro-Quebec, PQ, Canada). Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). 1974. (In French). (CONF-7403113–: Stockage de l'energie, Varennes (Canada), 20 Mar 1974; CE–02476). In *Symposium. Energy storage.* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This paper concerns hydrogen energy storage and the possibilities of this system. The system comprises an electrolysis unit which produces hydrogen, a liquefaction and storage unit, and a unit that regenerates electrical energy from hydrogen. It is illustrated by a project with 1000 MW peak power and 12,000 MWh stored energy. The characteristics of the electrolyzers and storage are discussed. To accumulate 700 tons of hydrogen, 40 nights of operation are needed; the volume of the liquid hydrogen is 2 M imperial gallons. Given the past experience with liquid hydrogen storage, safety is not a problem. The economics of fuel cells used to regenerate electrical energy are discussed. This system, with overall energy efficiency of 30%, is not profitable, but the profitability could be improved by selling hydrogen (for example, this hydrogen could be used to reduce iron ore), or by pre-enriching water vapor in deuterium (through isotopic exchange with gaseous hydrogen). Advantages and inconveniences of hydrogen energy storage are listed. In a postscript, the project is adapted to the more advantageous case of daily energy storage, with the possibility of producing 110 tons/y of D_2O. 5 refs., 6 figs., 4 tabs.

41799 (PB–89-862080/XAB) **Hydrogen production. September 1984-May 1989 (Citations from the NTIS data base). Report for September 1984-May 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 125p. Available from NTISPC N01/MF N01.

Supersedes PB–87-862280.

This bibliography contains citations concerning the manufacture of hydrogen by electrolysis, photosynthesis, and coal conversion processes. Topics include plant and process evaluations, theoretical aspects and laboratory investigations, and economic analyses. The utilization of thermonuclear reactors as a process energy source is also discussed. (This updated bibliography contains 212 citations, 46 of which are new entries to the previous edition.)

0802 Storage

Refer also to citation(s) 42174

41800 (AECL–9252) **Tritium in austenitic stainless steel vessels. Hydrogen effects on weld integrity.** Ells, C.E.; van der Kuur, J.H. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Jul 1986. 18p. Order Number DE89635421/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The vessel used for the long-term storage of tritium (titanium tritide) will be of welded 316L stainless steel construction. The 316L stainless is chosen partially because of its excellent resistance, in the wrought condition, to any degradation of mechanical properties from contact with hydrogen isotopes. The work reported here was undertaken to check that the welds in the vessel would have a satisfactory response to the hydrogen isotopes. A satisfactory response has been demonstrated, leading to a general conclusion that the titanium tritide/316L stainless steel vessel combination provides an extremely reliable storage facility for the tritium.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

Refer also to citation(s) 41594, 41849, 42389, 43025, 43026

41801 (DOE/ER/13730–3) **Enzymological studies of one-carbon reactions in the pathway of acetate utilization by methanogenic bacteria: Progress report, June 1, 1987–May 31, 1989.** Ferry, J.G. Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (USA). Dept. of Anaerobic Microbiology. 1 Jun 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-87ER13730. Order Number DE89016663/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The following major advances were made in the past two years: both acetate activating enzymes were characterized and the regulation of synthesis was studied; direct biochemical evidence for the proposed function of the CODH was obtained, and the CODH complex was further characterized; an electron transport chain was reconstituted with CODH, ferredoxin, and membrane components that catalyzed oxidation of carbon monoxide and evolution of hydrogen; the ferredoxin was characterized; five new enzyme activities were discovered with potential for involvement in growth and/or methanogenesis from acetate; probes were developed for isolation of the genes encoding the principle enzymes of the pathway. 6 refs., 3 figs.

41802 (DOE/PC/79935–3) **Inferring bubble size distributions from resistance probe measurements in gas-liquid, gas-slurry and three phase systems.** Clark, N.N.; Seiss, R.; Turton, R. West Virginia Univ., Morgantown, WV (USA). 1988. 24p. DOE Contract FG22-87PC79935. (CONF-881123–1: 3. international symposium on liquid-solid flows (WAM), Chicago, IL, (USA), November 28, 1988). Order Number DE88009626/JAW. Available from NTIS, PC A03/MF A01; GPO Dep.

Resistance probes measure the presence or absence of a conducting fluid at a point in multiphase flows. Although resistance probes are often used to determine local gas holdup in gas-liquid, gas-slurry and gas-liquid-solid flows, they are seldom used to find the bubble size distribution in the flow. This is due to the fact that the distribution of time intervals measured by the probe due to the passage of bubbles is not readily translated into a bubble size distribution. Even if a bubble rise velocity is known, the resulting distribution of bubble chord lengths cut by the probe has a lower mean and wider range than the size distribution. However, with enough data and a knowledge of the bubble shape it is possible to back transform to a size distribution. The current work deals with the case when the bubble shape is not a constant but changes with bubble size. Shape descriptors have been obtained from photographs of bubbles in water. Using these descriptors and probability density functions, a forward transform is developed to yield an expected chord length distribution for a given distribution of bubble sizes. The more important backward transform is accomplished numerically through a triangular matrix solution. Monte Carlo simulations demonstrate the correctness of this approach and are also used to show that the back transform can be unstable if too few data or too many size divisions in the matrix are used. 21 refs., 9 figs.

41803 (LU/GC–23440-4-9144) **Preparation of new catalysts based on ZSM5-supported metals for deoxygenation. Final report, 1984-1986.** Kaliaguine, S. Laval Univ., Quebec City, PQ (Canada). Dept. de Genie Chimique. 1986. 252p. (In French).

(MICROLOG–87-04546). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

The objectives of this research are to develop techniques for preparing and characterizing bifunctional metal/ZSM-5 zeolite catalysts, and to perform catalytic tests in order to compare deoxygenation activity. The research context is the development of a catalyst suitable for deoxygenation of organic oxygenates, such as biomass liquefaction products or low quality crudes, in situations where hydrogen is scarce and CO-rich gases are to be used for reduction. Three methods of catalyst preparation were tested, using an organometallic compound as the metal source and a post-synthesis introduction of this compound into the pore lattice of the zeolite. The catalyst characterization techniques included X-ray methods, atomic absorption, and spectroscopy. The catalytic tests were: methanol conversion (MTG), as in the Mobil M-gasoline process, to detect the changes in acidity of the support due to cationic exchange; Fischer-Tropsch synthesis in CO-rich conditions up to 400 degrees C, to investigate both the water gas shift activity and the hydrocarbon synthesis at the temperature optimal for MTG reaction on the acidic support; and reaction of methanol with carbon monoxide, combining the MTG reaction with the water gas shift reaction. Results indicated that calcination and gas phase adsorption were suitable catalyst preparation methods. MTG tests showed that supported oxides of Ru and Pd favor methanol decomposition. The Fischer-Tropsch tests showed that Fe/ZSM-5 is a good water gas shift catalyst and hydrocarbon synthesis catalyst at 400 C. The methanol-CO tests revealed that Fe/ZSM-5 allows simultaneous conversion of methanol to hydrocarbons and the water gas shift reaction. 98 refs., 43 figs., 52 tabs.

41804 (PB–89-184501/XAB) **Stabilization of crab scrap and processing waste water. Final report, 1984-1986.** Wolverton, B.C.; McCaleb, R.C. National Space Technology Labs., NSTL Station, MS (USA). 1 Dec 1986. 43p. Available from NTIS, PC A03/MF A01.

This report describes, in detail, the application of a National Space Technology Laboratories (NASA) developed technology involving anaerobic-digestion and microbial-filter processes as a possible solution to the blue crab waste-disposal problem. The project attempted to use this technology with crab waste and processing waste water to produce new products of organic fertilizer and methane (energy) while purifying the water to prevent nutrient enrichment of the Chesapeake Bay. Results of the project indicate that significant biogas production can be obtained with crab waste. However, digestion time is excessive, compared to that of cow manure. More work needs to be done on physical and/or chemical pretreatment to render the waste more amenable to digestion. The system was found costly and would not be practical except in periods of high energy prices.

41805 (PB–89-188833/XAB) **Catalysis of carbon gasification: influence of different modes of addition of catalysts. Annual report, January 1988-January 1989.** Richards, G.N. Montana Univ., Missoula, MT (USA). Wood Chemistry Lab. Mar 1989. 26p. Available from NTIS, PC A03/MF A01.

A polymer substrate with controlled carboxylic acid content was prepared by NO_2 oxidation of pure cellulose. The oxidation was found to be regiospecific to the C6 position, but the rate of oxidation, and hence the acid content, were difficult to control. Ion exchange of the oxidized cellulose yielded celluloses containing K and Ca, respectively, as the only metal ions. These were converted to chars and are being used for investigation of catalyst efficiencies in gasification and for examination of the chemical nature of the active catalyst in the char. The achievement of the latter target has been attempted by attentuated total reflectance Fourier Transform Infrared (FTIR) spectrometry and by X-ray diffraction (X-RD). Both of these methods however, were found to require conversion of the char to fine powder form and exposure as a thin-film during spectrometry. It is concluded that the complete protection of possible free metal or oxide from atmospheric water and CO_2 during such spectrometry is not feasible for K or Ca, and alternative forms of analysis are being developed. The FTIR and X-RD methods will be used in studies of heavier metals.

41806 (WLW–8802) **Ethanol from potato wastes.** Wardrop (W.L.) and Associates Ltd., Winnipeg, MB (Canada). 1988. 112p. (MICROLOG–89-00963). Available from Manitoba Legislative Library, 200 Vaughan St., Winnipeg, MB, CAN R3C 1T5; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Production of fuel or food/industrial grade ethanol from potato wastes at a food processing plant in Carberry, Manitoba offers excellent economic potential. It is estimated that seven million litres of anhydrous ethanol can be produced annually. Production could be as high as nine million litres per year, depending on the waste streams selected and on supplementation of the feedstock. Price of $0.30/l for fuel ethanol, and $0.35/l for food/industrial ethanol, could yield after-tax internal rates of return of 25-35%. Recovery of fermentable sugars from dilute waste streams through reverse osmosis has been determined to be desirable and consistent with the ethanol plant objectives. It will result in an increased capacity, will make acceptable quality water available for recycle, and will help offset the organic loading in the ethanol plant effluents. If these dilute wastes are neglected, production would drop by up to 800,000 l of ethanol per year, and a price increase of $0.05/l would be required to maintain the same rate of return. The project viability is enhanced if feedstock is supplemented with starch from a Winnipeg potato processing plant. This starch appears to be available at the cost of shipping is from Winnipeg to Carberry. Use of vapor recompression and heat pumps to replace steam for distillation has not been found to be economically viable because of low gas prices. A five stage, continuous fermentation process has been selected because of its lower costs and operating needs. A plant incorporating batch fermentation will require a price increase of $0.04/l to achieve comparable rates of return. A 25% increase in capital and operating costs will necessitate a $0.10/l price increase for both products and each scenario to maintain the after-tax rate of return in the range of 25-35%. 12 figs., 8 tabs.

0902 Alcohol Fuels

Refer also to citation(s) 41549, 41583, 42344, 42415, 42416, 42417, 42418

41807 (PB–89-175616/XAB) **Economics of ethanol production in the United States.** Kane, S.M.; Reilly, J.M. Economic Research Service, Washington, DC (USA). Resources and Technology Div. Mar 1989. 25p. (USDA/AER–607). Available from NTIS, PC A03/MF A01.

Expansion of the U.S. ethanol industry hinges largely on extension of the Federal fuel excise tax exemption and corn prices. For ethanol to be competitive in the 1990s without the Federal subsidy, crude oil prices would have to increase substantially. This report examines production costs and the relative competitiveness of the ethanol industry. The report evaluates structural characteristics of the industry, including economies of scale and the relative economics of the two primary manufacturers, wet- and dry-mill plants.

41808 (PB–89-861918/XAB) **Alcohol fuels. October 1985-October 1987 (Citations from the COMPENDEX data base). Report for October 1985-October 1987.** National Technical Information Service, Springfield, VA (USA). May 1989. 152p. Available from NTISPC N01/MF N01.

See also PB–89-861926.

This bibliography contains citations concerning the synthesis and utilization of alcohol fuels. Topics include synthesis from biomass and specific catalysts used in alcohol production, engine performance tests, and descriptions of various fuel blends. Some attention is given to economic aspects of production and future markets. (This updated bibliography contains 330 citations, none of which are new entries to the previous edition.)

41809 (PB–89-861926/XAB) **Alcohol fuels. November 1987-May 1989 (Citations from the COMPENDEX data base). Report for November 1987-May 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 70p. Available from NTISPC N01/MF N01.

Supersedes PB–88-851258. See also PB–89-861918.

This bibliography contains citations concerning the synthesis and utilization of alcohol fuels. Topics include synthesis from biomass and specific catalysts used in alcohol production, engine performance tests, and descriptions of various fuel blends. Some attention is given to economic aspects of production and future markets. (This updated bibliography contains 129 citations, all of which are new entries to the previous edition.)

0904 Solid Waste and Wood Fuels

Refer also to citation(s) 41433, 42377, 42389, 43033, 43398

41810 (DOE/OR/21389–21) **Northeast Regional Biomass Energy Program: Progress report, April 1989–June 1989.** O'Connell, R. CONEG Policy Research Center, Inc., Washington, DC (USA). Jul 1989. 11p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG05-83OR21389. Order Number DE89015927/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Northeast Regional Biomass Program (NRBP) was initiated in August 1983 with a grant to the Coalition of Northeastern Governors (CONEG), Policy Research Center, Inc. from the US Department of Energy's Oak Ridge Operations Office. The program is designed to promote the responsible use of biomass energy in the Northeast region which encompasses eleven states (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island and Vermont). The Program conducted by NRBP has three basic features: (1) a state grant component that provides funds (with a 50 percent matching requirement) to each of the state agencies involved in biomass energy; (2) a series of technical reports and studies in areas that have been identified as being of critical importance to the development of biomass energy in the region; and, (3) a continuous long range planning component with heavy private sector involvement that helps to identify activities necessary to spur greater development and use of biomass energy in the Northeast.

41811 (PB–89-168116/XAB) **Charcoal. Technical digest.** de Bont, I.G.M. Council for Scientific and Industrial Research, Pretoria (South Africa). 1987. 26p. (TECHNICAL DIGEST–1). Available from NTIS, PC EE05/MF E05.

North American Continent sales only.

Contents include: Introduction - principle of carbonization; carbonization equipment; kiln carbonizers; retort carbonizers; selection of wood; sizes and preparation of wood; loading and operation of carbonizers; yields; uses of charcoal; sources; references selected from the manufacturing technology reviews (mtr) data base; references selected from the National Timber Research Institute hout data base; reports on charcoal issued by the National Timber Research Institute of the CSIR; books available from the CSIR library; standards for charcoal; South African standards; standards from other countries.

41812 (PB–89-187157/XAB) **New Mexico's 1986 fuel-wood harvest. Forest Service resource bulletin.** McLain, W.H. Forest Service, Ogden, UT (USA). Intermountain Research Station. Apr 1989. 13p. (FSRB/INT–60). Available from NTIS, PC A03/MF A01.

The estimated fuelwood harvest in New Mexico in 1986 was 197,198 cords (15.5 million cubic feet). The fuelwood harvest volume was 52% as large as the volume of sawlogs and other industrial roundwood products harvested. The volume of live timber trees harvested for fuelwood was 5,141 cords (399,000 cubic feet), less than 1% of the total harvest of roundwood products in 1986. The report presents harvest volumes by species, county, and owner. An appendix lists a directory of commercial fuelwood cutters. The method of data collection and compilation are explained.

13 HYDRO ENERGY

Refer also to citation(s) 41916

1301 Resources and Availability

Refer also to citation(s) 42175

41813 (EC/IWD–1987AP) **Atlantic Provinces historical water levels summary, to 1985.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1987. 31p. (In English and French). (MICROLOG–87-02956). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of monthly and annual mean water levels and annual extremes of water levels, for lakes and rivers in Newfoundland and Laborador, New Brunswick, Nova Scotia, and Prince Edward Island. Historical data are included as far back as 1918, when hydrometric data were collected by the Dominion Water Power Branch; subsequent federal-provincial agreements provided for collection of water survey data on a shared basis. Data have also been provided by private companies and electric utilities. Descriptive information about the gauging stations is also included, such as location, type of gauge, and whether the flow is natural or regulated.

41814 (EC/IWD–1987M) **Manitoba historical water levels summary, to 1985.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1987. 128p. (In English and French). (MICROLOG–87-03764). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of monthly and annual mean water levels, and annual extremes of water levels, for lakes and rivers in Manitoba. Historical data are included back to 1912, and have been supplied by federal and provincial agencies. Descriptive information about the gauging stations is also included, such as location, type of gauge, and whether the flow is natural or regulated.

41815 (EC/IWD–1987O) **Ontario historical water levels summary, to 1985.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1987. 147p. (In English and French). (MICROLOG–87-03739). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of monthly and annual mean water levels, and annual extremes of water levels, for lakes and rivers in Ontario. Data have been collected since the early 1900s by the Hydro-Electric Power Commission of Ontario, and later on by the Dominion Water and Power Bureau and by federal-provincial cooperative agreements. Descriptive information about the gauging stations is also included, such as location, type of gauge, and whether the flow is natural or regulated.

41816 (EC/IWD–1987Q) **Quebec historical water levels summary, to 1985.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1987. 229p. (In English and French). (MICROLOG–87-05370). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of monthly and annual mean water level, and annual extremes of water levels, for lakes and rivers in Quebec. Historical data extend as far back as the early 1900s, having been collected by various provincial and federal agencies and organizations, including Hydro-Quebec. Descriptive information about the gauging stations is also included, such as location, type of gauge, drainage area, and whether the flow is natural or regulated.

41817 (EC/IWD–1987S) **Saskatchewan historical water levels summary, to 1985.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1987. 92p. (In English and French). (MICROLOG–87-03951). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of monthly and annual mean water levels, and annual extremes of water levels, for lakes and rivers in Manitoba. Historical data are provided as far back to 1922, when hydrometric surveys were conducted by the Dominion Water Power

Branch. Surveys since 1930 have been conducted under federal-provincial agreements. Descriptive information about the gauging stations is also included, such as location, type of gauge, and whether the flow is natural or regulated.

41818 (EC/WID–1987) **Surface water data: Yukon and Northwest Territories, 1986.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1987. 128p. (In English and French). (MICROLOG–87-05369). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of daily water level or discharge, monthly and annual mean water levels, and monthly and annual discharge information (total, mean value, and maximum and minimum values) at locations on lakes and rivers in the Yukon and Northwest Territories. Data have been collected for the year 1986 by the water Survey of Canada with contributions by other federal organizations such as the Northern Canada Power Commission. Descriptive information about the gauging stations is also included, such as location, type of gauge, ice conditions, drainage area, and whether the flow is natural or regulated.

41819 (EC/WID–1987) **Surface water data: Manitoba, 1986.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1987. 197p. (In English and French). (MICROLOG–87-05850). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of daily water level or discharge, monthly and annual mean water levels, and monthly and annual discharge information (total, mean value, and maximum and minimum values) at locations on lakes and rivers in Manitoba. Data have been collected for the year 1986 by the water Survey of Canada with contributions by other federal and provincial organizations and private companies, including electric utilities. Descriptive information about the gauging stations is also included, such as location, type of gauge, ice conditions, drainage area, and whether the flow is natural or regulated.

41820 (EC/WID–1987) **Surface water data: Atlantic Provinces, 1986.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1987. 147p. (In English and French). (MICROLOG–87-05371). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of daily water level or discharge, monthly and annual mean water levels, and monthly and annual discharge information (total, mean value, and maximum and minimum values) at locations on lakes and rivers in Newfoundland and Labrador, Prince Edward Island, Nova Scotia, and New Brunswick. Data have been collected for the year 1986 by the water Survey of Canada with contributions by other federal and provincial organizations and private companies, including electric utilities. Descriptive information about the gauging stations is also included, such as location, type of gauge, ice conditions, drainage area, and whether the flow is natural or regulated.

41821 (EC/WID–1987BC) **Surface water data: British Columbia, 1986.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1987. 322p. (In English and French). (MICROLOG–87-05373). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of daily water level or discharge, monthly and annual mean water levels, and monthly and annual discharge information (total, mean value, and maximum and minimum values) at locations on lakes and rivers in British Columbia. Data have been collected for the year 1986 by the water Survey of Canada with contributions by other provincial organizations and private companies, including electric utilities. Descriptive informatin about the gauging stations is also included, such as location, type of gauge, ice conditions, drainage area, and whether the flow is natural or regulated.

41822 (EC/WID–1987O) **Surface water data: Ontario, 1986.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1987. 300p. (In English and French). (MICROLOG–87-05852). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of daily water level or discharge, monthly and annual mean water levels, and monthly and annual discharge information (total, mean value, and maximum and minimum values) at locations on lakes and rivers in Ontario. Data have been collected for the year 1986 by the water Survey of Canada with contributions by other federal and provincial organizations and private companies, including electric utilities. Descriptive informatin about the gauging stations is also included, such as location, type of gauge, ice conditions, drainage area, and whether the flow is natural or regulated.

41823 (EC/WID–1987Q) **Surface water data: Quebec, 1986.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1987. 54p. (In English and French). (MICROLOG–87-05781). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of daily water level or discharge, monthly and annual mean water levels, and monthly and annual discharge information (total, mean value, and maximum and minimum values) at locations on lakes and rivers in Quebec. Data have been collected for the year 1986 by the water Survey of Canada with contributions by other federal and provincial organizations. Descriptive information about the gauging stations is also included, such as location, type of gauge, ice conditions, drainage area, and whether the flow is natural or regulated.

41824 (EC/WID–1987S) **Surface water data: Saskatchewan, 1986.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1987. 206p. (In English and French). (MICROLOG–87-05372). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of daily water level or discharge, monthly and annual mean water levels, and monthly and annual discharge information (total, mean value, and maximum and minimum values) at locations on lakes and rivers in Saskatchewan. Data have been collected for the year 1986 by the Water Survey of Canada with contributions by other federal and provincial organizations and private companies, including electric utilities. Descriptive information about the gauging stations is also included, such as location, type of gauge, ice conditions, drainage area, and whether the flow is natural or regulated.

1302 Site Geology and Meteorology

Refer also to citation(s) 43700

41825 (OH/RD–88-11-K) **Seismic testing of earth dyke at DeCew Falls GS.** Koopmans, R. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 44p. (MICROLOG–89-02565). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A seismic survey was conducted at various locations on and near the DeCew Falls earth dyke during the months of August and September, 1987. The purpose of the program was to provide additional input into the geotechnical investigation aimed at determining the overall stability of the earth dyke. This report provides the locations of the surveys, as well as the velocities and depths of the various strata detected during the testing program. In an effort to verify the measurements from each location, the survey was conducted in reverse as well. The results are based on the authors' interpretation of the data, since some of the surveys were affected

by wind, construction and traffic noise. They appear to be realistic for all surveys except for those conducted along DeCew Road, which may have been affected by the presence of the pavement. Surveys in the valley area suggest a pronounced decrease in the bedrock elevation. 35 figs., 1 tab.

1303 Plant Design and Operation

41826 (MH–722-G626) **Post-tensioning of concrete semi-spiral case and intake piers for hydraulic structures.** Manitoba Hydro, Winnipeg, MB (Canada). 1989. vp. (CE–02697). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The objective of this study was to assess the feasibility of using post-tensioned concrete as an alternative to conventional reinforced concrete for hydraulic structures. This study followed an earlier investigation into the technical feasibility and reliability of post-tensioned concrete for hydraulic structures. Designs incorporating post-tensioning were prepared for comparison with existing reinforced concrete semi-spiral case walls and intake piers of a close-coupled intake and powerhouse with vertical units. Design analysis was done using a personal computer-based, finite-element program called ANSYS. The design criteria, materials, and design methods used for the study are presented along with two alternative post-tensioned designs for a semi-spiral case and intake. The cost and construction implications for the two designs are also presented. Additional potential applications for post-tensioning are identified. 17 refs., 38 figs., 7 tabs.

41827 (OH/RD–88-151-K) **Eugenia GS [generating station] intake structure concrete investigation.** Caratin, H. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 9p. (MICROLOG–89-02549). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An investigation into the condition of the concrete forming the intake structure at Eugenia hydro-electric generating station indicates that the concrete has severely deteriorated due to freeze-thaw action and ice abrasion. More detailed investigation and remedial action are recommended. 4 figs., 2 tabs.

1305 Economics and Management

Refer also to citation(s) 41833, 41834

1306 Environmental Aspects

41828 (MEW/WS–8703) **Canada-Manitoba agreement on the study and monitoring of mercury pollution in the diversion system of the Churchill River. Summary report and technical appendices.** Manitoba Dept. of Environment and Workplace Safety and Health, Winnipeg, MB (Canada). Water Standards and Studies Section. 1987. 1382p. (MICROLOG–87-06181). Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Lake Winnipeg, Churchill-Nelson River Hydroelectric Project in northern Manitoba includes river diversions that resulted in extensive areas of flooded terrain. Elevated mercury levels in fish from lakes along the diversion were noted, and concern for the possible health and economic impacts has led to a federal-provincial agreement to study the problem. There was no indication of elevated levels of natural Hg, and no evidence of important man-made sources. Methyl mercury, the predominant form of mercury in fish, is produced naturally in aquatic environments in small amounts by bacterial methylation. Studies done under the agreement found that net methylation rates were highest in the flooded areas, and that there was a high correlation between methylation rates and mercury levels in fish. It was also known that the most important factor affecting those rates is the amount and type of flooded organic material. At least in the case of moss-peat material, a doubling of the amount of this material resulted in a doubling of mercury accumulated in fish. It was also found that a wide variety of organic materials could stimulate the bioaccumulation of mercury in fish, indicating that the effect of flooding on mercury levels in fish is a general response. Another important factor is the amount of oxygen present; very low oxygen levels mean higher net methyl mercury production. The overall results of the agreement and other recent studies indicate that elevated mercury levels in fish following impoundment is a widespread problem that must be taken into account when planning future impoundment or reservoir projects. Includes glossary and an appendix of 14 related technical papers. 3 refs., 36 figs., 14 tabs.

41829 (MM–1664) **Fish passage mortality in a tube turbine.** Ruggles, C.P.; Palmeter, T.H. Monenco Maritimes Ltd., Fredericton, NB (Canada). 1989. 70p. (MICROLOG–89-02525). Available from Canada Dept. of Fisheries and Oceans, Scientific Publications, 200 Kent Street, 14th. Floor, Ottawa, ON, CAN K1A 0E6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Fish passage tests in a tube-type turbine located on the Sissiboo River, Nova Scotia, were conducted using juvenile trout, alewife, and yellow perch. The average turbine-related mortality was estimated to be 18 to 25% for trout, 14% for alewife, and 13.6% for yellow perch. Water temperature was the most significant variable influencing fish mortality during passage through the turbine. Data are presented which indicate that previous estimates of juvenile alewife mortality due to turbine passage at other hydroelectric sites may be too high. 76 refs., 13 figs., 12 tabs.

41830 (PB–89-182984/XAB) **Evaluation of dissolved oxygen monitoring locations and flow patterns below Conowingo Dam.** Wendling, L.C. Versar, Inc., Columbia, MD (USA). Apr 1989. 58p. Available from NTIS, PC A04/MF A01.

Philadelphia Electric Company (PECO) presently monitors dissolved oxygen (DO) concentration at a single fixed station (Shure's Landing) downstream of the Conowingo dam to determine compliance with Maryland water quality standards. As part of a 1988 Settlement Agreement, Philadelphia Electric Power Company and the Susquehanna Power Company (the Licensees) were required to determine whether the monitor at Shure's Landing accurately measures the effect of actions taken by the Licensees to comply with the DO standard. These actions include the installation of venting systems at seven units by August 1991, as well as the possibility of spills over the dam. Concurrent testing of oxygen injection and air injection would be undertaken. Unit 5 was aerated in 1988 and two more units are scheduled to be aerated each year thereafter. The study determines whether the present intake site for PECO's DO monitor samples water that is representative of discharge water from all turbines under a variety of operating scenarios and identifies alternate monitor location(s) which would more accurately depict the DO of water discharged from any combination of the turbines.

41831 (PB–89-189781/XAB) **Impact of small-scale hydropower on fish populations in the Upper Mississippi River and recommendations for mitigation. Technical report.** Baines, B.; Baker, J.; Biasetti, S.; Carson, H.; Clark, R. Duke Univ., Durham, NC (USA). School of Forestry and Environmental Studies. 1988. 86p. Available from NTIS, PC A05/MF A01.

The project is part of the National Network for Environmental Management Studies (NNEMS) under the auspices of the Office of Cooperative Environmental Management of the U.S. Environmental Protection Agency. The report analyzes potential impacts on the fisheries resources in the Upper Mississippi resulting from the development of small-scale hydropower in the Mississippi River. The six objectives of the study are to review different types of hydropower, determine potential effects on fish, compile a representative list of potentially impacted species and their life history characteristics, quantitatively predict potential fluctuations of sport-fish populations, evaluate strategies for mitigating adverse effects on fish, and develop a list of criteria for evaluating prospective hydropower sites. The study concludes that mechanical damage, caused by the runner blades, wicket gates, and guide vanes of the turbines, is the greatest source of both lethal and sublethal injury to fish.

1307 Power-conversion Systems

41832 (EGG-M–89190) **Characteristics of Independent Turbine Testing Facility.** Olivier, C.; Voigt, R.L.; Gulliver, J.S.; Arndt, R.E.A. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 9p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC07-76ID01570. (CONF-890876–2: Waterpower '89: international conference on hydropower, 23-25 Aug 1989). Order Number DE89016353/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Independent Turbine Testing Facility (ITTF) located at the St. Anthony Falls Hydraulic Laboratory has recently undergone extensive upgrading, funded by a grant from the small hydropower program of the US Department of Energy. Shakedown of the upgraded facility has been completed. The facility shakedown provides definitive answers regarding its capabilities and operational characteristics. This paper desires the upgraded facility, its resultant capabilities and characteristics, as well as its usefulness to the hydropower community. 6 refs., 3 figs.

41833 (EPRI-GS–6419-Vol.1) **Hydropower plant modernization guide: Volume 1, Hydroplant modernization, Final report.** Electric Power Research Inst., Palo Alto, CA (USA); Black and Veatch/Motor Columbus, Associates, Kansas City, MO (USA). Jul 1989. 504p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Hydroplant Modernization Guide provides a screening procedure and criteria to enable utility personnel to identify which hydroelectric plants are potentially suitable for modernization. Guidance is provided to help utility personnel assess the condition of existing plant components so that modernization alternative plans can be postulated, the associated optimum component capabilities selected, and related costs estimated. The guide presents a method of evaluating the alternative modernization plans and comparing their costs to operating benefits. An appendix demonstrates how to use the guide by evaluating a rehabilitation project, evaluating the options, and developing the most cost-effective plan. 21 refs., 121 figs., 42 tabs.

41834 (EPRI-GS–6419-Vol.2) **Hydropower plant modernization guide: Volume 2, turbine runner upgrading, Final report.** Electric Power Research Inst., Palo Alto, CA (USA); Black and Veatch/Motor Columbus, Associates, Kansas City, MO (USA). c Jul 1989. 374p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The initial sections of the Turbine Runner Upgrading Guide provide a screening procedure and criteria to help utility personnel identify which hydroelectric plants on their system are potentially suitable for turbine runner upgrading. A Feasibility section demonstrates how to determine if turbine performance can be improved and the potential improvement. The guide presents methods for evaluating component condition and describes various modernization alternatives for the turbine runner and other hydraulic components, the generator and auxiliaries, the generator transformer and switchgear. The relationships between major components and the uprating limitations they impose on each other are discussed. Ranges of cost estimates (in 1987 dollars) and required lead times for delivery or fabrication of components are given. The guide includes a brief section on typical economic evaluation methods. A detailed case study demonstrates the use of the material contained in the guide. Finally, guidance is provided for the procurement of runner upgrading, turbine overhaul, turbine model tests and generator rewinding. 92 figs., 36 tabs.

41835 (SFWE–1989) **Turbine generating sets.** Stapenhorst (F.W.E.), Inc., Pointe Claire, PQ (Canada). [1989]. vp. (CE–02684). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This report is about the turbine generating sets developed by F.W.E. Stapenhorst Inc., Pointe Claire, Quebec in order to exploit small dams for the generation of additional hydro-electric power. Considerable research was carried out with particular emphasis on supplying hydro-electric generating equipment which could easily cope with variations in head and water discharge. The Ossberger turbine is a radial, impulse-type turbine with partial admission that is a low-speed turbine; its characteristics and performance are discussed. Generating sets are also discussed. Plans of installations and letters of endorsement from users are provided. 22 figs., 6 tabs.

14 SOLAR ENERGY

1403 Economics

Refer also to citation(s) 41859

1405 Solar Energy Conversion

Refer also to citation(s) 41433, 41801, 41805, 41857, 41885, 42386, 42791, 43352, 43359, 43552, 43554, 43577, 44284

41836 (AD-A–206808/8/XAB) **GaAsP top solar cells for increased solar-conversion efficiency. Final report, June 1985-September 1988.** McNeely, J.B.; Negley, G.H.; Barnett, A.M. Astrosystems International, Inc., Newark, DE (USA). Astropower Div. Jan 1989. 49p. Available from NTIS, PC A03/MF A01.

The development of multijunction solar cells is the key to achieving large increases in solar-power conversion efficiency over current state-of-the-art technology. In the optimal multijunction design, the top solar cell is the most critical since, by itself, it generates two-thirds of the total power generated by the solar cell stack. There are two viable technical approaches for the top solar cell for the mechanically-stacked tandem solar cell: GaAsP/GaP and AlGaAs/AlGaAs. Both top solar cell approaches have demonstrated good device properties. No other approach has made acceptable devices.

41837 (ADI–1989) **Supplement to a study of the economic availability of wood residues for fuel in New Brunswick.** Adi Ltd., Fredericton, NB (Canada). [1989]. 89p. (MICROLOG–89-02880). Available from New Brunswick Dept. of Natural Resources and Energy, P.O. Box 6000, Fredericton, NB, CAN E3B 5H1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Data are presented on the reported production of wood residues from primary and secondary wood producers, and from processing and manufacturing operations, in New Brunswick. Also included is information on the reported consumption of New Brunswick wood residues for energy inside and outside the province. The data are presented according to name of producing company and the company address, phone number and name of contact are also given. Total reported production from primary and secondary producers in 1987 was 637,700 bone dry tonnes (BDT), and 1,017,016 BDT from processing and manufacturing. Total reported consumption figures for use inside New Brunswick and outside the province are 921,847 and 145,930 BDT/y respectively. 22 refs., 4 figs., 7 tabs.

41838 (CONF-890509–3) **Gas holdup in three-phase immobilized cell bioreactors.** Bajpai, R.; Thompson, J.E.; Davison, B. Oak Ridge National Lab., TN (USA). 1989. 21p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From 11. symposium on biotechnology for fuels and chemicals; 8-12 May 1989. Order Number DE89016334/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A number of studies in the published literature deal with gas holdup in three-phase reactors. However, very few address the cases in which the solid density approaches that of the liquid phases and where low gas velocities are involved. These conditions are commonly encountered in immobilized-cell bubble columns and in fluidized-bed bioreactors. This paper reports the effect of gas and liquid velocity upon gas holdup and bed expansion in fluidized-bed bioreactors. For liquid-fluidization of low-density alginate beads in the absence of gas, the terminal sedimentation velocity (v_T), of the particles is a constant and expansion of the bed follows Richardson and Zaki's correlation. In the presence of gas, however, the apparent terminal sedimentation velocity value is affected by the velocity of the gas and liquid phases. For gas velocities above a minimum value, the calculated value of v_T depends upon liquid velocity only and a constant bed expansion was observed for a range of gas and

liquid flow rates. For the gas-liquid interactions, a modified drift-flux model was found to be valid. For superficial gas velocities between 5 and 17 cm/min, the modified drift-flux velocity was observed to be a function of gas velocity suggesting the prevalence of a coalescence regime. 21 refs., 4 figs., 1 tab.

41839 (CONF-8808262–1) **Applications of remote sensing to forested ecosystems.** Iverson, L.R.; Graham, R.L.; Cook, E.A. Oak Ridge National Lab., TN (USA). [1988]. 36p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Annual meeting of the Ecological Society of American on satellite remote sensing in ecology; 12-19 Aug 1988. Order Number DE89016160/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Since the launch of the first civilian earth-observing satellite in 1972, satellite remote sensing has provided increasingly sophisticated information on the structure and function of forested ecosystems. Forest classification and mapping, common uses of satellite data, have improved over the years as a result of more discriminating sensors, better classification algorithms, and the use of geographic information systems to incorporate additional spatially referenced data such as topography. Land-use change, including conversion of forests for urban or agricultural development, can now be detected and rats of changes calculated by superimposing satellite images taken at different dates. Landscape ecological questions regarding landscape pattern and the variables controlling observed patterns can be addressed using satellite imagery as can forestry and ecological questions regarding spatial variations in physiological characteristics, productivity, successional patterns, forest structure, and forest decline. 91 refs., 1 fig.

41840 (DOE/ER/13188–6) **Nitogen control of chloroplast development and differentiation: Technical progress report.** Schmidt, G.W. Georgia Univ., Athens, GA (USA). Dept. of Botany. Jul 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract FG09-84ER13188. Order Number DE89015801/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This project concerns the role of nitrogen availability in regulation of photosynthetic gene expression in the nuclear and chloroplast compartments. These studies exploit a continuous culture system wherein Chlamydomonas reinhardtii is maintained at a steady-state of nitrogen-limited growth. Nitrogen deficiency leads to alteration of light-harvesting capabilities, augmentation of chlororespiratory electron transport flow by thylakoid membranes and redirection of photosynthetic carbon metabolism toward the accumulation of storage carbohydrates. Recovery from nitrogen-deficiency with accompanying changes in gene expression rapidly follows provision of ammonium to the cells. Previously, we found that expression of nuclear genes encoding apoproteins of light-harvesting complexes and, to a lesser extent, the small subunit of ribulose 1,5-bisphosphate carboxylase/oxygenase, are strongly regulated at the level of mRNA accumulation. Chloroplast activities are also strongly influenced by nitrogen availability but the effect is primarily due to restrictions of the translation of some, but not all, organellar mRNAs. No qualitative or quantitative effects on chloroplast (or mitochondrial) transcripts have been detected in northern analyses performed to date nor is there an appreciable effect of nitrogen limitation on the abundance of organellar DNA. 4 figs., 1 tab.

41841 (DOE/OR/21390–24) **Great Lakes Regional Biomass Energy Program: Quarterly report, March 1, 1989–May 31, 1989.** Kuzel, F. Council of Great Lakes Governors, Chicago, IL (USA). Jun 1989. 37p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG05-83OR21390. Order Number DE89015928/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This is the third quarterly report of the sixth year of operation of the Great Lakes Regional Biomass Energy Program. The program was initiated in 1983 with a grant to the Council of Great Lakes Governors from the Biofuels and Municipal Waste Technology Division of the US Department of Energy. Stressing near-term biomass feedstock production techniques and conversion processes, the objective of the program is to increase the use of biomass energy by the public and private sectors in the seven state Great Lakes region. States that are in the Great Lakes region include: Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio and Wisconsin.

41842 (DP–1763) **Forest land application of sewage sludge on the Savannah River Plant.** Davis, C.E. (comp.). Westinghouse Savannah River Co., Aiken, SC (USA). 31 May 1989. 244p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. Order Number DE89014018/JAW. Available from NTIS, PC A12/MF A01 - OSTI; GPO Dep.

In 1980, a sewage sludge application study was initiated on the Savannah River Plant to evaluate the effects of sludge additions on nutrient cycling processes in loblolly pine (Pinus taeda L.) forest ecosystems and to determine whether or not such additions beneficially enhance forest productivity. Sewage sludge, either as a liquid anaerobic sludge at 0, 402, or 804 kg N/ha (360 and 720 lb/ac) containing approximately 7% N (oven dry) or a solid aerobic material at 632 kg N/ha (560 lb/ac) with approximately 1.3% N (oven dry), was applied to 1-, 3-, 8-, and 28-year-old loblolly pine stands on sandy and clayey upper coastal plain soils. A total of 525,000 gallons of liquid sludge and 560 tons of solid sludge was applied on 11.6 hectares (28.7 acres) of loblolly pine forest plots. Sludge additions were monitored to determine availability and movement so that potential impacts could be evaluated on water quality, nutrient and heavy metal cycling, soil and forest floor, understory vegetation, tree foliage, stand growth, biomass production, and wood quality. This study concluded that using liquid sludge at rates of 400 kg N/ha or less as a silvicultural treatment to fertilize pulp and sawtimber loblolly pine stands resulted in increased forest productivity without environmental or wood quality degradation. Application recommendations for stand age and loading rates for management purposes are addressed.

41843 (ENEA-RT-FARE–88-14) **Amorphous silicon solar cells: antireflective and conductive coatings.** Antonaia, A. ENEA, Rome (Italy). Dec 1988. 32p. (In Italian). Order Number DE89761944/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Transparent conductive tin oxide films for photovoltaic solar cells were fabricated by low temperature spray pyrolysis. The deposition temperature ranged between 220C and 300C and fluorine doping was realized by adding increasing concentrations of HF into the solution. Resistivity measurements showed that the electrical properties of the tin oxide improve as either the deposition temperature or the doping concentration increase. On the other hand, the transmittance evidences a maximum when measured as a function of doping concentration. To optimize the growth conditions, a figure of merit F, given by the product of the resistivity times the absorption coefficient, was utilized.

41844 (ETDE-mf–9795695) **Electric properties of amorphous silicon (a-Si:H) and amorphous alloys (a-$Si_{1-x}C_x$:H, a-$Si_{1-x}Ge_x$:H). Final report.** Carius, R.; Finger, F.; Fuhs, W.; Mell, H.; Weiser, G.; Beyer, W. Marburg Univ. (Germany, F.R.). Fachbereich 13 Physik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Jun 1987. 77p. (In German). Contract BMFT 03E-8327-A. Order Number DE89795695/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; NTIS (US Sales Only), PC A05/MF A01.

Thin films of a-Si:H, a-$Si_{1-x}Ge_x$:H and a-$Si_{1-x}C_x$:H have been prepared by the decomposition of SiH_4 and gas mixtures of SiH_4 and GeH_4 or CH_4, respectively, in a rf glow discharge. For undoped a-Si:H we investigated the applicability of various methods of photocurrent spectroscopy for the determination of the density and energy distribution of localized gap states. To further clarify the recombination mechanism in undoped and doped a-Si:H films a combination of various techniques has been applied: stationary and time-resolved photoconductivity, luminescence and light-induced electron spin resonance (LESR) using single- and dual-beam excitation. Information on the localized tail states and the dominating defects in a-$Si_{1-x}Ge_x$:H has been obtained from ESR and LESR studies. For a-$Si_{1-x}C_x$:H alloys we have studied the variation of the optical constants and of the stationary and time-resolved luminescence. These data provide information on the bonding conditions in these alloys and on the life-time for radiative recombination. The density of hydrogen, its bonding configurations and the microstructure of films from both alloy systems have been inferred from measurements of hydrogen effusion and infrared absorption. (orig.) With 97 refs., 44 figs.

41845 (ETDE-mf–9911049) **Development of new process technologies for solar cells with high efficiency manufactured from unconventionally purified silicon. Final report.** Goetzberger, A.; Voss, B. Fraunhofer-Institut fuer Solare Energiesysteme (ISE), Freiburg im Breisgau (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Jul 1987. 50p. (In German). Contract BMFT 03E-8258. Order Number DE89911049/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01.

Influences on diffusion length as the dominating materials parameter of crystalline silicon have been investigated. Especially doping level impurity concentration and process diffused defects have been considered. Results: For a water thickness of 300 μm the optimum resistivity was found to be about 0.5 Ωcm. Independent of their exact position within the bandgap all impurities are of critical influence in low resistivity material. Slow diffusing elements like Ti, Mo may be acceptable only in concentrations smaller 10^{-8} at/cc. Only fast diffusing elements like nickel may be sufficient getterable. Process induced defects may be avoided by suitable ramp rates. FZ- and poly silicon require cooling rates of only a few degree C/min, while CZ-silicon requires about 50 degree C/min. Low energy hydrogen implantation yields efficiency improvements which mostly have to be attributed to the passivation of volume defects rather than grain boundaries. (orig.) With 26 refs., 1 tab., 32 figs.

41846 (ETDE-mf–9911082) **Amorphous silicon solar cells. Phase III. Final report.** Guenzel, E.; Juergens, W.; Kausche, H.; Kruehler, W.; Kusian, W.; Karg, F.; Pfleiderer, H.; Plaettner, R.; Stetter, W. Siemens A.G., Muenchen (Germany, F.R.). Forschungslaboratorien; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Feb 1988. 138p. (In German). Contract BMFT 03E-8430 A. Order Number DE89911082/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; NTIS (US Sales Only), PC A07/MF A01.

By a series of fundamental investigations a broader basis for the start of production of amorphous silicon solar cells has been established. Textured SnO_2:F films with very high diffuse transmission have improved the spectral response of the cells by 20% as compared to commercially available substrates. The photosensitivity σ_{ph}/σ_d of a-SiGe material with a bandgap of 1.5 eV was improved up to a value of $8x10^3$ under Am1 illumination. a-Si:H solar cells with an efficiency of 7.5% at a bandgap of 1.5 eV have been fabricated. Homogeneous silan plasmas covering an area up to 0.75 m x 0.75 m for the production of large cells have been achieved. The influence of contamination and doping profiles during amorphous silicon deposition on the efficiency and stability of the cells was investigated. Low priced patterning methods without any laser for the series connection of the cells in thin film technology have been developed. An efficiency of 7.5% was achieved with modules, 10 cm x 10 cm wide. (orig./ORU) With 76 refs., 13 tabs., 79 figs.

41847 (NRC–1986) **Development of an analytical methodology for the characterization of the products of biomass and peat liquefaction.** Bouchard, J. National Research Council of Canada, Ottawa, ON (Canada). 1986. 195p. (In French). (MICROLOG–87-04598). Available from National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, ON, CAN K1A 0R6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report describes the wood and peat liquefaction processes (fractionation and solvolysis) developed at the University of Sherbrooke, Quebec, and the analytical methods used to characterize the liquefaction products. The methods include standard analysis of components such as humidity, ash, lignin, and cellulose; sample preparation techniques; thermogravimetry; and analysis of macromolecules, oligomers, and monomers. The organization of an analytical laboratory that has been set up to carry out these processes and methods is also outlined. The analytic methodology that has been developed appears to permit a satisfactory analysis of the samples examined in order to optimize the liquefaction process. The results have led to development of new analytical methods and research projects At present, these projects include structural and chemical studies of cellulose, hydrolysis of starch, steam treatments, and pretreatments of lignocellulosic materials and peat. 5 refs., 20 figs., 12 tabs.

41848 (NUKEM-FuE–86008) **Technology for the production of large area solar generators. Pt. 2. Final report.** Campe, H. v.; Hoffmann, W.; Woerner, J. Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Hanau (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Jun 1987. 27p. (In German). Contract BMFT 03E-8027-B. Order Number DE89795918/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01.

Due to cost considerations the substrate for amorphous silicon modules should consist of alkaline containing glass. In order to prevent alkaline ions from penetrating the TCO- and amorphous silicon-material, diffusion blocking layers, consisting of silicon oxide, have been produced. The highly conductive component within the TCO-material is made of indium-tin-oxide (ITO). These layer have been reactively sputtered; after a specified heat treatment they obtain both high optical transparency and low specific resistance. Between the highly conductive ITO-layer and the subsequent amorphous silicon it is appropriate to have an additional layer consisting of transparent and low conductive material in order to minimize the influence of pin-hole defects. For this purpose tin-oxide layers, deposited by a reactive sputtering process, have been tested. (orig.).

41849 (PB–89-178503/XAB) **Biomass energy industry sourcebook.** Troxell, D.L. Illinois Dept. of Energy and Natural Resources, Springfield, IL (USA). Office of Solid Waste and Renewable Resources. Mar 1989. 48p. (IL/ENR/AE–89/01). Available from NTIS, PC A03/MF A01.

See also PB–88-150875.

The report is a directory of persons/establishments involved with different aspects of the biomass energy industry. These include consulting, engineering design, construction, manufacturing, retail, information, education, and research. Listings include name, address, phone, and a brief description of each firm/organization. Entries are categorized as follows: Consultants and Engineers, Alcohol Production Equipment/Systems, Methane Production Equipment/Systems, Combustion Equipment/Systems, Fuel Processing, Harvesting Equipment/Systems, Silviculture, Transportation, Storage, and Handling, Information Sources, and Databases. The report has been expanded and revised from a previous edition.

41850 (PB–89-178958/XAB) **Twig and foliar biomass estimation equations for major plant species in the Tanana River basin of interior Alaska. Forest Service research paper.** Yarie, J.; Mead, B.R. Forest Service, Portland, OR (USA). Pacific Northwest Research Station. Sep 1988. 27p. (FSRP-PNW–401). Available from NTIS, PC A03/MF A01.

Equations are presented for estimating the twig, foliage, and combined biomass for 58 plant species in interior Alaska. The equations can be used for estimating biomass from percentage of the foliar cover of 10-centimeter layers in a vertical profile from 0 to 6 meters. Few differences were found in regressions of the same species between layers except when the ratio of foliar-to-twig biomass changed drastically between layers, for example, Rosa acicularis Lindl. Eighteen species were tested for regression differences between years. Thirteen showed no significant differences, five were different. Of these five, three were feather mosses for which live and dead biomass are easily confused when measured.

41851 (SERI/STR–211-3238) **High-efficiency $CuInSe_2$ and $CuInGaSe_2$ based cells and materials research: Annual subcontract report, 1 November 1987–31 October 1988.** Devaney, W.E.; Chen, W.S.; Stewart, J.M. Solar Energy Research Inst., Golden, CO (USA); Boeing Electronics High Technology Center, Seattle, WA (USA). Jun 1989. 30p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89009449/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The results of the first year of a two-year research program are presented. A 1-cm^2 ZnO/CdZnS/$CuInGaSe_2$ solar cell with total-area efficiency of 12.5% (AM1.5, 100mW/cm^2) has been fabricated. The quantum efficiency of this device at 400 nm exceeds 0.7 as a result of the improved transmission of the ZnO/thin CdZnS window

layers. The fabrication and characteristics of each of the three layers and of the complete devices are discussed. Results on gallium doping of CdZnS window layers are presented. Three-layer antireflection coatings for $CdZnS/CuInSe_2$ cells are single-layer coatings for $ZnO/CdZnS/CuInGaSe_2$ structures have been designed and deposited. Results on devices made using high-gallium-content $CuInGaSe_2$ are discussed. 12 refs., 12 figs.

41852 (SERI/STR-211-3522) **Low-cost technique for producing $Cd_{1-x}Zn_xTe$ devices for cascade cell application: Final subcontract report, 1 June 1987–15 December 1988.** Basol, B.M.; Kapur, V.K.; Kullberg, R.C. Solar Energy Research Inst., Golden, CO (USA); International Solar Electric Technology, Inglewood, CA (USA). Jun 1989. 23p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89009433/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report contains results on research into a low-cost technique for producing $Cd_{1-x}Zn_xTe$ devices for cascade cell application. Specifically, the work investigated a two-stage process for producing $Cd_{1-x}Zn_xTe$ devices with a transparent contact and a band gap of about 1.7 eV. The two-stage technique involves depositing thin films of Cd, Zn, and Te in the form of stacked layers, and then heating the layers to form the compound. The feasibility of the technique was demonstrated. Extrinsic doping of the films was achieved. Transparent ZnTe film having low resistivity that will be useful as transparent ohmic contacts to the layers were obtained. Solar cells processed by the two-stage technique were demonstrated. 11 refs., 8 figs., 1 tab.

41853 (STEV-EO–89-12) **Plant cultivation Salix. Final report of the period 1986-04-01–1989-03-31.** Gullberg, U. Swedish Univ. of Agricultural Sciences, Uppsala (Sweden). Dept. of Forest Genetics; Statens Energiverk, Stockholm (Sweden). 1988. 139p. (In Swedish, English). (SLU-ISG–41). Order Number DE89902459/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

Within the long term breeding we have concentrated on S. viminalis and S. dasyclados. New base material has been collected and parts of the first and second generation of the breeding population has been produced. We have also established experiments with the collected material, with species hybrids and with a model species (Brassica) in order to see how the breeding population should be structured and enlarged. Our results imply that it might be profitable to grow energy forestry even in northern Sweden and that S. dasyclados could be preferable to S. viminalis in some areas. In the short term program we have started one selection line during the last three year period and for the moment there are 110 families and 250 clones in different selection steps. We have also established trials in order to estimate the breeding potential. Parts of our material has also been sent for testing to the commercial breeding company Svaloef AB. Our results show that breeding of Salix could give considerable improvements in the plant performance what regards growth capacity and disease tolerance. So far, however, it is difficult to quantify the gains since the breeding goals and the selection methods still are fairly imprecise.

41854 Sensitization and photoredox reactions of zinc(II) and antimony(V) uroporphyrins in aqueous media. Kalyanasundaram, K. (Sandia National Labs., Albuquerque, NM (USA)); Shelnutt, J.A.; Graetzel, M. *Inorganic Chemistry (USA),* 27(16): 2820-2825 (10 Aug 1988).

The utility of Zn(II) and Sb(V) uroporphyrins ($Zn^{II}UroP^{8-}$, $Sb^{V}(O)(Cl)UroP^{8-}$) as photosensitizers for redox processes in solution and in photoelectrochemical systems involving large band gap semiconductors has been investigated by steady-state and flash photolysis techniques. The reductive quenching of these porphyrins by EDTA is an efficient process, SbUroP yielding stable porphyrin anions in aqueous solution. In three-component systems (involving sensitizer-viologen-EDTA), extensive ground-state complexation of ZnUroP with MV^{2+} drastically reduces the efficiency of the sensitization process. The corresponding system based on Sb(O)UroP however gives reasonable net yields of reduced viologen upon photolysis. Flash photolysis studies using colloidal TiO_2 indicate that charge injection occurs from both the singlet and triplet excited states of ZnUroP. 17 references, 6 figures, 1 table.

41855 Achieving high quantum yield charge separation in porphyrin-containing donor-acceptor molecules at 10 K. Wasielewski, M.R. (Argonne National Lab., IL (USA)); Johnson, D.G.; Svec, W.A.; Kersey, K.M.; Minsek, D.W. *Journal of the American Chemical Society (USA),* 110(21): 7219-7221 (12 Oct 1988). DOE Contract W-31-109-ENG-38.

In order to study the rates and energetics of electron-transfer reactions related to photosynthesis, two new fixed-distance donor-acceptor molecules have been prepared. The donors are Zn porphyrins, and the acceptor is a high-electron affinity tetracyanonaphthoquinodimethane derivative. These compounds posses very large negative free energies for charge separation at 294 K. It was found that the very low quantum yields for charge separation in low temperature solids exhibited by the porphyrin-based donor-acceptor molecules resulted in a large part from destabilization of the ion pair state in low-temperature solids relative to polar liquids. 15 references, 2 figures, 1 table.

1406 Photovoltaic Power Systems

41856 (ENEA-RT-FARE–85-1) **Technical-economical analysis of photovoltaic systems for residential use.** Barra, L.; Lavorante, F.; Sarno, A. Naples Univ. (Italy). Ist. di Fisica; ENEA, Rome (Italy). Jan 1985. 31p. (In Italian). Order Number DE89761945/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A technical and economical analysis of a PV system for a remote location is performed. A method is presented to determine the cheapest solution for the photovoltaic array and the storage capacity of the system which a LOLP (loss of load probability) of 1%. Finally the NPW (net present value) method is applied to analyze the investment.

41857 (ENEA-RT-FARE–88-07) **Delphos photovoltaic plant start-up: performance.** Fabriani, L.; Messina, G.; Romanazzo, M. ENEA, Casaccia (Italy). Dipt. Fonti Alternative e Risparmio Energetico. Jul 1988. 72p. (In Italian). Order Number DE89761843/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

This paper describes the details of automatic measurements taken on the photovoltaic pilot plant DELPHOS. Photovoltaic plant and transformation unit performance were analyzed. Total energy balances relative to the whole plant and each subsystem were examined. Based on a total of 132 MWh produced, 122 delivered to the inverter - transformer set (average net output greater than 92%) of which 177 were let into the ENEL (Italian National Electricity Board) grid and the rest used for plant services.

41858 (ENEL–430.153-7) **Proposal of a simplified lay-out of monitoring systems for small stand-alone PV plants.** Brambilla, C.; Iliceto, A.; Previ, A. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Oct 1986. 9p. Order Number DE89761925/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

In this paper, an approach to low cost DAS for small stand-alone photovoltaic plants is illustrated. It is shown how energy balances and diagnostics of plant operation can be achieved. Two examples of low-cost, high simplicity and high reliability data acquisition systems are also illustrated.

41859 Remote applications of photovoltaic systems. Post, H.N. (Sandia National Labs., Albuquerque, NM (US)); Jones, G.J.; Thomas, M.G.; Casbarro, J.J.; Piror, K. vp. of Energy technology XVI. Government Institutes Inc., Rockville, MD (1989). (CONF-890213–: 16. annual energy technology conference, 28 Feb - 2 mar 1989).

Thousands of photovoltaic (PV) systems exist worldwide providing power to small remote grid-independent applications such as telecommunications and vaccine refrigeration where PV is the economic power option of choice. These applications are characterized by the need for a highly reliable source of electrical energy to meet relatively small loads in areas where conventional sources are too costly to install and/or cannot be maintained. A major application for photovoltaics, that of rural electrification, is currently receiving considerable interest not only by potential users who need a reliable source of electrical power but also by several U.S. electric utilities who see a new and potentially significant market.

1407 Solar Thermal Power Systems

41860 Thermal/hydraulic analysis of a commercial-size cavity receiver. Carli, G. (9508602). *Journal of Solar Energy Engineering (USA),* 111(2): 184-188 (May 1989).

This paper presents the results of the thermal/hydraulic analysis of a commercial-size molten salt solar central cavity receiver. Included are a description of the receiver; performance characteristics; sensitivity of salt and tubewall temperatures to variations in heat flux, flow distribution, and uncertainties in design parameters.

41861 Analysis of composite stretched-membrane heliostats. Kiang, H.J. (9501454); Dharan, C.K.H. *Journal of Solar Energy Engineering (USA),* 111(2): 103-111 (May 1989).

The stretched-membrane concept has the potential for reducing the cost of heliostats used for solar thermal energy generation in central receiver systems. In this concept, a high strength/structural membrane carrying the reflective film is stretched uniformly on a toroidal frame. The resulting structure has high stiffness and is structurally efficient. It is practically suitable for composite materials, since the loading is primarily in-plane. In this paper, the application of composite materials to stretched-membrane heliostat design is investigated. The results of the analysis show that composite materials for both the membrane and the frame exhibit significant advantages over metals. These include high strength-to-weight design, higher resistance to wind-induced deformation, the possibility of independently tailoring bending and torsional stiffness, and better transportability.

41862 The power production operation of Solar One, the 10 MWe Solar Thermal Central Receiver Pilot Plant. Radosevich, L.G. (9511238); Shinrood, A.C. *Journal of Solar Energy Engineering (USA),* 111(2): 144-151 (May 1989).

Solar One, the 10 MWe Solar Thermal Central Receiver Pilot Plant near Barstow, Calif., completed a three-year period of power production testing in July 1987. During this period the plant's capacity factor, system efficiency, and availability were studied to assess the operational capability of Solar One to reliably supply electrical power. The long-term performance of keyplant components, such as the heliostats and the receiver, was also studied. During the three years of power production operation, Solar One achieved increases in capacity factor, system efficiency, and availability. Heliostat operation was reliable, and only small amounts of mirror corrosion were observed.

41863 Thermal modeling of solar central receiver cavities. Skocypec, R.D. (9511412); Romero, V. *Journal of Solar Energy Engineering (USA),* 111(2): 117-123 (May 1989).

Results are presented from a numerical model of the steady-state energy transfer in molten-salt-in-tube solar cavity receivers that includes convective energy transfer at a local (spatially resolved) level. Molten salt energy absorption and gray radiative transfer between all cavity surfaces are also included. This model is applied to the Molten Salt Subsystem Component Test Experiment (MSS/CTE) cavity receiver. Results for this receiver indicate the global (entire cavity) receiver thermal efficiency is invariant within a few percent to most parameters investigated, although front surface temperatures of the nonabsorbing walls vary considerably, and are particularly sensitive to the type of convective submodel used. Absorption efficiencies indicate the effects of the cavity enclosure environment. For all conditions investigated, tube inner wall temperatures remain under 855 K, ensuring that the salt remains chemically stable.

41864 Heat transfer modeling of the IEA/SSPS volumetric receiver. Skocypec, R.D. (9511412); Boehm, R.F.; Chavez, J.M. *Journal of Solar Energy Engineering (USA),* 111(2): 138-143 (May 1989).

During the summer and fall of 1987 in Almeria, Spain, a wire-pack receiver was tested by the International Energy Agency/Small Solar Power Systems (IEA/SSPS). The basic operation of the receiver is that: air is drawn through several layers of stainless steel wire screen; concentrated solar flux is directed on the face of the screen pack; the oxidized wires absorb the solar energy; and heat is transferred to the air flowing through the screen. Although the experiment goal was strictly proof-of-concept and was not receiver characterization, modeling efforts were initiated to help understand the experimental results. The steady-state performance of the receiver is modeled using the fact that the net solar and infrared radiative energy absorbed by each screen layer must be transferred to the air by convection. Basic performance trends and typical calculations of receiver efficiency are given. Model predictions and experimentally measured temperatures and flow rates are compared.

1409 Solar Thermal Utilization

Refer also to citation(s) 41880

41865 (AU/EE–06041981) **A study of air. Mediated solar heating systems with long-term storage. Final report.** Robinson, A.M.; Cathiell, D.L.; Hargrove, W.H.; Haswell, P. Alberta Univ., Edmonton, AB (Canada). Dept. of Electrical Engineering. 6 Apr 1981. 87p. (CE–02731). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

The study described in this report was undertaken to investigate the feasibility of employing air collectors and using seasonal heat storage to meet the full space heat and domestic hot water requirements for a single family residence. Ten Canadian locations were considered in the investigation. From the wide variety of air solar collectors available, a high performance evacuated tube (ET) collector and a simple site-assembled flat plate (FP) collector were chosen for the study. The choice for heat storage was an insulated rock bed located in the basement. A computer model was developed to simulate such systems in order to determine the performance and important operating characteristics. The use of two storage volumes instead of a single volume was investigated as a means of improving the overall performance of the seasonal heating system. Increasing the efficiency of the collectors by pumping air at twice the standard flow rate was also considered. The final computer simulations examined the performance of the heating system by determining a number of combinations of collector area and storage volume which would satisfy the same heating load. The optimal system configuration was the combination resulting in minimum cost for the collectors and storage. The detailed costs of such systems were estimated. Two economic analyses were performed to compare the optimal solar heating systems with conventional heating systems. A simple payback analysis and a more detailed present worth analysis were used for all locations. Both analyses show that for any realistic set of economic assumptions, seasonal storage solar heating is not economically favourable commpared with conventional heating. 33 refs., 14 figs., 14 tabs.

41866 (DFVLR-FB–85-36) **Measurement of radiation intensity at the solar tower plant SSPS/CRS of the IEA in Spain.** Brinner, A. Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.). 1985. 43p. (In German). Order Number DE89911461/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01.

A measuring device with a KENDALL radiometer and a measuring method have been developed to calculate with the measurement results the radiant power input on the solar absorber of the solar tower plant SSPS/CRS. With this measuring device the absolute level of the radiation can be measured point-focal at different places of the absorver. During an international measurement campaign in 1984 a series of measurements has been performed. The results show a high accuracy and good reproducibility. Therefore, they can be used furthermore and the development of the measurement device is finished. (orig.) With 9 figs., 7 tabs., 6 refs.

41867 (ENEA-RT-FARE–85-6) **Passive solar space heating systems for residential buildings: technical-economical analysis methodology.** Fanchiotti, A.; Manna, C.; Matteoli, S. ENEA, Frascati (Italy). Centro Ricerche Energia. May 1985. 33p. Order Number DE89761940/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A recent Italian Energy Conservation Act enables regional administrations to finance, upon the basis of a technical-economical analysis, energy saving projects in the residential building sector. Passive solar space heating technologies, due to the non-linearity and time-dependence of all phenomena, require more complex

analyses. The method described in this paper solves these problems through simplification that, while assuring acceptable levels of reliability, allow easy access to non-technical users. First, it is necessary to define a reference building, since "savings" have to be estimated. The method proposes rules of generation of such a reference building. Average daily energy consumptions, both for the proposed and for the reference building, are computed. Consumption is derived based on the "gains utilizability" concept. The algorithms used to evaluate solar gains through passive components and the monthly utilizability coefficients are derived, with adjustments, from those of "Methode 5000". Energy performance and economic aspects are summarized by means of some performance factors, allowing comparisons between different solutions.

41868 (ENEA-RT-FARE–88-10) **Passive solar design methods for Italy. Report for ENEA in the framework 1 January to 30 April 1988.** Jones, R.W. ENEA, Rome (Italy). Oct 1988. 128p. Order Number DE89761955/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

The manual provides guidelines relevant to solar load ratio calculation, conservation and aperture areas, direct gain glazing, thermal storage walls (Trombe walls), doorway sizing and sunspaces in natural convective heat distribution systems, the use of the annual load collector ratio (LCR) method for annual auxiliary heat requirement estimation, diurnal heat capacity (DHC) and effective heat capacity (EHC) calculation. Examples of passive design illustrate the application of design methodologies for multi-family residential building, art galleries and schools. Tables provide Italian weather and insolation data and solar load ratio correlations.

41869 (IEA–9015961) **Task 8, Passive and hybrid solar low energy buildings: Subtask A, Performance evaluation procedures.** Moerck, O. (ed.); Holtz, M.; Swisher, J.; Blomsterberg, A.; Jacobsen, T. International Energy Agency, 75 - Paris (France); Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering; Architectural Energy Corp., Boulder, CO (USA); Statens Provningsanstalt, Stockholm (Sweden); Selskapet for Industriell og Teknisk Forskning, Trondheim (Norway). Oct 1988. 127p. Order Number DE89015961/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI.

This document presents the common monitoring and performance evaluation procedures used by the participants of IEA Task VIII – Passive and Hybrid Solar Low Energy Building – to evaluate the passive and hybrid solar homes constructed as part of this international cooperative research effort. Although the performance evaluation procedures were developed specifically for Task VIII, they are useful for any monitoring activity involving passive and hybrid solar homes. The document is organized into seven chapters. Each chapter addresses a different requirement of a successful performance evaluation program. The early chapters (1 and 2) discuss the elements of a monitoring project and the necessity for clearly defining the monitoring objectives. Chapter 3 presents the performance evaluation methodology for passive and hybrid solar homes, including a list of common performance factors. Chapters 4 and 5 discuss the preparation of the monitoring plan and establishing the data and instrumentation requirements. Chapter 6 discusses data reduction procedures, while Chapter 7 presents a recommendation for documenting the building, passive and hybrid system, the data acquisition system and the results. 36 refs.

41870 (IEA-SHCP–9B-1) **Validation of models for estimating solar radiation on horizontal surfaces: Final report: Task IX.** Davies, J.A.; McKay, D.C.; Luciani, G.; Abdel-Wahab, M. International Energy Agency, 75 - Paris (France). Programme to Develop and Test Solar Heating and Cooling Systems. Jun 1988. 167p. Sponsored by International Energy Agency. Order Number DE89016434/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI.

The report presents the findings of an international collaborative study performed by Task IX, Solar Radiation and Pyranometry Studies, of the International Energy Agency's Solar Heating and Cooling Program. The overall objective of this study was to evaluate the performance of numerical models which provide estimates of solar irradiance on horizontal surfaces.

41871 (PB–89-180418/XAB) **Solar energy for utilization in a Georgia rest area (space and domestic water heating). Final report, 1984-1987.** Vollo, S.D. Georgia Dept. of Transportation, Atlanta, GA (USA). Research and Development Bureau. Jun 1988. 28p. Available from NTIS, PC A03/MF A01.

This report presents data acquired for a thermal solar-energy system. Data was obtained after completion of the new solar rest area building and instrumentation incorporated. Collection of data began in 1984 and continued on through 1987. The solar system provides space and domestic water heating for a rest area situated on I-75 in the vicinity of Calhoun, Georgia. An analysis of the data collected shows that for two comparative 12-month periods savings in electrical energy consumption increased substantially. Total solar fractions for the earlier 12-month period were 33% whereas for the latter period the solar fraction was 70% of the total energy load.

41872 (PB–89-862122/XAB) **Solar drying of crops and food. January 1970-May 1989 (Citations from the COMPENDEX data base). Report for January 1970-May 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 76p. Available from NTISPC N01/MF N01.

Supersedes PB–86-876612.

This bibliography contains citations concerning the utilization of solar thermal systems in food and crop-drying operations. Descriptions and evaluations of specific operations and associated equipment are discussed, as well as economic considerations. Direct crop drying, and the use of desiccants in specific applications are described, and computer simulation studies are included. (This updated bibliography contains 193 citations, 24 of which are new entries to the previous edition.)

1410 Solar Collectors and Concentrators

Refer also to citation(s) 41878

41873 (AU/ME–08-U-79-9) **Application of boiling and condensation heat transfer to flat plate solar collectors in cold region. Final report.** Cheng, K.C. Alberta Univ., Edmonton, AB (Canada). Dept. of Mechanical Engineering. 1982. vp. (CE–02671). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This final report presents the results of four experimental investigations relating to 2-phase thermosyphon flat-plate solar collectors for possible applications in cold regions. Performance characteristics of a conventional hydronic flat-plate solar collector system were studeed in a cold region at low flow rate. For this study, the Revere liquid solar collector system was used with pure propylene glycol as working fluid. Simultaneous thermal performance comparison tests were performed on hydronic and 2-phase thermosyphon flat-plate solar collector systems. Both experimental systems utilized Revere solar collector panels and side-by-side experiments were conducted. The hydronic system used 60% propylene glycol-water solution and the 2-phase thermosyphon system used Freon R-113 as the working fluid. For the 2-phase system, a commercially available double pipe coiled heat exchanger was used. Simultaneous thermal performance tests were performed on hydronic and refrigerant-charged flat-plate solar collector systems. For the 2-phase thermosyphon system, a passive refrigerant charged phase change solar water heating system was used Operating characteristics of a 2-phase thermosyphon flat-plate solar collector system were studied using R-11 and R-113 as working fluids by indoor test. In this study, solar irradiation was replaced by electric heating of the absorber plate from the back side of the collector panel. The significant implications of the present investigation and the potentials of the 2-phase thermosyphon flat-plate solar collector system for applications in cold regions are pointed out. The current status of commercial development and published results on the 2-phase refrigerant charged solar collector systems for domestic water heating are reviewed briefly. 39 refs., 74 figs., 11 tabs.

41874 (AU/ME–U-79-9) **Application of boiling and condensation heat transfer to flat plate solar collectors in cold region. Twelve month report.** Cheng, K.C. Alberta Univ., Edmonton, AB (Canada). Dept. of Mechanical Engineering. 1981. 153p.

(CE–02672). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This report presents the results of the following investigations: an experimental and theoretical study of a thermosyphon system for solar collector applications (water as working fluid); experiments on a 2-phase thermosyphon system for solar collector applications in cold regions (Freon R-113 as working fluid); and experiments on a 2-phase thermosyphon flat plate solar collector in cold regions (Freon R-113 as working fluid). The natural circulation test loop (thermosyphon system) was designed and constructed to simulate the flat plate solar collector applications under single phase and 2-phase flow conditions using water and refrigerant Freon R-113 as working fluids. Flow and heat transfer measurements are presented. 2-phase flow patterns and instability were observed. The experimental 2-phase thermosyphon flat plate solar collector system using freon-R-113 as a working fluid was installed. Experimental results on flow and heat transfer are presented. Within the scope of the present investigation, a maximum system efficiency of 53% was obtained. The feasibility of 2-phase thermosyphon flat plate solar collectors for applications in cold regions was confirmed. With further improvements in design such as the reduction of 2-phase flow resistance, these solar collector systems may have much higher efficiency than the conventional forced liquid circulation system currently in use. 39 refs., 66 figs., 1 tab.

41875 (DOE/AL/21557–T13) **Calculation of the optical power profile for a solar bowl with an iris.** Anderson, R.M.; Obeyesekere, M. Texas Tech Univ., Lubbock, TX (USA). Dept. of Mathematics. 15 May 1987. 92p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-83AL21557. Order Number DE89015784/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report develops analytical techniques for studying shallow spherical segment bowls that have an attached tracking iris. The report extends previous analytical models that were developed as part of the Crosbyton Solar Power Project for the case of spherical segment bowls. Three types of calculations are considered. First, effective apperture formulas are derived for a spherical segment bowl with an iris, and results are compared with the bowl without an iris. Secondly, analytical formulas are derived to determine spillage losses for shallow bowls. Finally, the powerful Ratio of Solid Angles (ROSA) computer code is extended to include solar profiles for a spherical segment bowl with iris. The report includes several plots comparing optical power concentration ratios for solar bowls with and without an iris. A complete listing of the extended code, ROSAIRIS, is given in the appendix. 29 figs.

41876 (ITL–8509, pp. 518-521) **The Groningen project. 96 solar houses with seasonal heat storage in the soil.** Wijsman, A.J. (TNO Inst. of Applied Physics, Delft, Netherlands). Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A project in which seasonal solar heat was stored in the upper layer of soil was carried out in Groningen, the Netherlands. The project consists of 96 solar houses, each with 25 m^2 of high performance solar collectors mounted on the south facing roof, and a seasonal heat store of about 23,000 m^3 (depth 20 m) of water saturated sandy soil. The seasonal heat store in the soil consists of a layer of soil in which a vertical tube heat exchanger is inserted. Only the top of the store is furnished with an insulation layer. The paper provides a description of the entire solar heating plant. Design backgrounds are given in brief. The experience with the first half year of system operation is discussed. To get more information about the operation of the plant, the entire system will be monitored until the spring of 1986.

41877 (PB–89-176333/XAB) **Flat steel roof as a solar collector for winter heating of a test building.** Joubert, P.H.; Wentzel, J.D.; van Wamelen, J. Council for Scientific and Industrial Research, Pretoria (South Africa). National Building Research Inst. 1987. 17p. (R/BOU–1497). Available from NTIS, PC EE04/MF E04.

North American Continent sales only.

This document describes how indoor air temperatures can be raised by using air heated by its contact with hot roof sheeting. The rate of airflow required for adequate heating is identified.

1420 Heat Storage

Refer also to citation(s) 41863, 41876, 42179, 42180, 42183, 42191, 42192, 42308

41878 (ITL–8509, pp. 471-474) **Comparison of concepts for central solar heating plants with seasonal storage.** Krischel, D. (Interatom GmbH, West Germany). Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A wide spectrum of central solar heating plants with seasonal storage (CSHPSS) including different storage and collector types, control strategies, and system layouts has been simulated with the MINSUN program. In parallel MINSUN has been validated using the well known TRNSYS code. In general, the characteristics of MINSUN and TRNSYS results are in acceptable agreement. The most remarkable difference is a more pronounced temperature stratification from the MINSUN model. This is caused by variable temperature controlled storage inlets and outlets on both the collector and load side. Also, somewhat higher solar fractions from MINSUN result from the fact that devices are missing that might reduce the amount of usable solar energy, e.g. heat exchanger between collector array and storage tank. The direct collector-to-load connection increases the solar fraction only for systems without heat pumps. For well stratified storages an additional buffer is of minor importance. Large-scale systems comprising uncovered collectors with heat pumps are found to be more economic and thermally efficient CSHPSS under German economic and climatic conditions than evacuated tube collector systems without heat pumps. Soil may be used as additional storage capacity. CSHPSS (water storage) systems are not yet cost competitive compared to conventional energies. 3 refs., 5 figs.

41879 (ITL–8509, pp. 513-517) **A new interseasonal storage concept for solar heat applications in private buildings in moderate climates.** Weik, H. (Fachhochsclule Luebeck, Luebeck, Germany). Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A new storage concept is described that makes it possible to utilize solar insolation for year round solar heating of one to four-family residential buildings. The idea is to employ a double-storage unit, consisting of two water tanks of different size and temperature level. A tank of about 4 m^3 volume kept at 35 to 50^{0}C satisfies the heat demand of the low-temperature heating system of the building, while the second tank of some 20 m^3 volume serves as heat reservoir and, in mid-winter, as heat source for a small heat pump of 2 kW driving power, operating between the two tanks. Since summer 1982, the concept has been tested in a one-family home with 130 m^2 heated area built at the site of the Fachhochschule Lubeck. The first three heating seasons proved the feasibility of the concept and also validated all expectations as to general and insolation economics. Particularly, as to the latter aspect, the inherent peculiarity

of the double-storage systems shows its merits in that the low temperature of the storage medium during the phase change process allows the collector field (size 30m^2) to collect even very small solar radiation rates with high efficiency, providing a continuous supply of low-grade solar heat, necessary to operate the heat pump. This permits keeping both the collector field and the volume of the heat-reservoir tank within an economically reasonable size and limits the auxiliary energy demand to less than 6000 kWh per heating period for the total thermal load of the house. 7 refs., 4 figs.

41880 Convective heat transfer coefficients from a full-scale test in the REPEAT facility. Kahwaji, G. (9501278); Burns, P.J.; Winn, C.B. *Journal of Solar Energy Engineering (USA)*, 111(2): 132-137 (May 1989).

Convective heat transport coefficients are computed from data obtained from a full-scale test in a closely controlled, passive solar sunspace. The subtractive convective heat transport at the surface is calculated from the conductive and radiative fluxes. Methods for calculating these fluxes from measured data, and estimating best fit coefficients are presented. The results obtained are found to be in very good agreement with an independent approach used to analyze the same data sets.

15 GEOTHERMAL ENERGY

1502 Geology and Hydrology of Geothermal Systems

Refer also to citation(s) 41881

1503 Geothermal Exploration and Exploration Technology

41881 (AU/P–8212) **A preparatory study for application of geothermal energy in the Hinton/Edson area of Alberta. Quarterly report, October-December 1982.** Jones, F.W.; Rahman, M.; Lam, H.L. Alberta Univ., Edmonton, AB (Canada). Dept. of Physics. 1982. 13p. (CE–02669). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This report discusses a literature survey of well conditions favourable for conversion to geothermal energy production, a review of well information from 18 wells, the acquisition of a geothermal well modelling program from the University of Regina and its adaptation to the University of Alberta computer, and initial discussions concerning engineering aspects of the problem. Also, some preliminary contacts with individual government departments as well as with industry personnel concerning possible geothermal energy use have been made.

41882 (ETDE-mf–9795478) **Hot Dry Rock Project, Los Alamos. Final report.** Keppler, H. Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (Germany, F.R.); Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Energieforschung. Mar 1986. 122p. (In German). Contract BMFT 03E-4408-A/1. Order Number DE89795478/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01.

After the successful termination of phase I of the project (1975 to 1980), phase II was intended to explore deeper and hotter strata. For this purpose, two separate boreholes were to be connected by rock fracturing. The project failed in spite of the many fracturing experiments carried out between 1982 and 1984. Greater success was granted to the experiments on directional drilling through rock zones showing seismic activity during the period of reservoir genesis. The findings of phase II yielded new insight into the problems in establishing a Hot Dry Rock system. Although the system established in phase II was bigger and hotter than the system of phase I, it is still lower by about one order of magnitude than the envisaged 'quasi-economical' system (35 MW for 15 years). (RB).

1505 Economic and Financial Aspects

Refer also to citation(s) 41881

1506 Environmental Aspects and Waste Disposal

41883 (PB–89-180145/XAB) **Feasibility of penaeid culture in geothermal brackish ground water in southwestern Arizona.** McNelis, B. Gila River Fishery, Tucson, AZ (USA). 11 Nov 1986. 19p. Available from NTIS, PC A03/MF A01.

The primary objectives of this research was to determine growth, survival, and feed conversion ratios of Penaeus vannamei grown inland in geothermally warmed brackish ground water. P. vannamei is an important species of marine shrimp (Family: Penaeidae) which is cultured commercially in South America, Central America, and Hawaii. The single source of ground water used for shrimp growout was assayed for mineral content, and its composition was compared to that of other Arizona sources of geothermal ground water and seawater. The culture water was monitored regularly for temperature, oxygen, and ammonia concentrations, and pH. The results of two independent shrimp-growth trials beginning at PL-5 (five-day old post larvae) were used to determine the feasibility of this novel method of cultivating a tropical marine species in an inland temperate location.

1507 By-products

41884 (AD-A–205940/0/XAB) **Hydrocarbons in surface sediments from a Guaymas Basin hydrothermal vent site. Technical report.** Bazylinski, D.A.; Farrington, J.W.; Jannasch, H.W. Woods Hole Oceanographic Institution, MA (USA). 1988. 13p. (WHOI-CONTRIB–6766). Available from NTIS, PC A03/MF A01.

Pub. in Organic Geochemistry, Vol. 12, No. 6, 547-558(1988).

Petroleum-like materials found at the Guaymas Basin hydrothermal vent site (Gulf of California) are derived from pyrolysis of organic matter. Two characteristics surface sediment cores differing in temperature profiles and other parameters were collected by DSV ALVIN, sectioned, and analyzed for hydrocarbons. The quantitative and qualitative composition of alkanes, steranes, diasteranes, and triterpanes differed between these cores as well as within sections of the same core. These differences, apparent for scales of tens of centimeters, are related to interactive physical, chemical, and microbial processes as well as the influence of multiple sources for the petroleum.

41885 (AD-A–205942/6/XAB) **Extremely thermophilic fermentative archaebacteria of the genus desulfurococcus from deep-sea hydrothermal vents. Technical report.** Jannasch, H.W.; Wirsen, C.O.; Molyneaux, S.J.; Langworthy, T.A. Woods Hole Oceanographic Institution, MA (USA). May 1988. 9p. (WHOI-CONTRIB–6681). Available from NTIS, PC A02/MF A01.

Pub. in Applied and Environmental Microbiology, Vol. 54, No. 5, 1203-1209(May 1988).

Two strains of extremely thermophilic, anaerobic bacteria are described that are representative of isolates obtained from a variety of oceanic hydrothermal vent sites at depths from 2,000 to 3,700 m. The isolates were similar in their requirements for complex organic media, elemental sulfur, and seawater-range salinities (optimum, 2.1 to 2.4%); their high tolerance for sulfide (100 mM) and oxic conditions below growth-range temperatures (50 to 95%C); and their archaebacterial characteristics: absence of murein, presence of certain di-and tetraethers, and response to specific antibiotics. The two strains (S and SY, respectively) differed slightly in their optimum growth temperatures (85 and 90 C), optimum pHs for growth (7.5 and 7.0), and DNA base compositions (52.01 and 52.42 G+C mol%). At their in situ pressure of about 250 atm (25,313 kPa), growth rates at 80 and 90 C were about 40% lower than those at 1 atm (101.29 kPa), and no growth occurred at 100 and 110 C, respectively, at either pressure. In yeast extract medium, only 2% of the organic carbon was used and appeared to stem largely from the proteinaceous constituents. According to physiological criteria, the isolates belong to the genus Desulfurococcus.

1508 Geothermal Power Plants

41886 (EGG-M–89001) **Relative performance of supercritical binary geothermal power cycles with in-tube condensors in different orientations.** Bliem, C.J.; Mines, G.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 7p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC07-76ID01570. (CONF-890815–21: 24. intersociety energy conversion engineering conference, Washington, DC (USA), 6-11 Aug 1989). Order Number DE89016199/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Heat Cycle Research Program, which is conducted for the Department of Energy, has as its objective the development of the technology for effecting the improved utilization of moderate temperature geothermal resources. The current testing involves the investigation of the performance of binary power cycles utilizing mixtures of non-adjacent hydrocarbons as the working fluids, with supercritical vaporization and in-tube condensation. The utilization of these concepts will improve the net geofluid effectiveness (net plant output per unit mass of geofluid) about 20% over that of a conventional binary power plant. The major prerequisite for this improvement is the achievement of integral, countercurrent condensation. Results are presented for testing of the performance of the condenser at different tube inclinations. The performance in the vertical orientation is better than in either the horizontal or inclined orientations. 7 refs., 8 figs.

1509 Geothermal Engineering

Refer also to citation(s) 41882, 41886, 41890

41887 (EGG-M–89077) **Geothermal direct use engineering and design guidebook avialable for an expanding market.** Lunis, B.C.; Lienau, P.J. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 7p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC07-76ID01570. (CONF-8903124–2: Geothermal program review meeting, Washington, DC (USA), 15 Mar 1989). Order Number DE89016197/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Geothermal direct use industry potential, growth trends, needs, and how they are being met, are addressed. The high potential for industry growth, coupled with a rapidly expanding use of geothermal energy for direct use, and concerns over the greenhouse effect is the setting in which a new engineering and design guidebook is being issued to support the growth of the geothermal direct use industry. Recent investigations about the current status of the industry and the identification of technical needs of current operating district heating systems provide the basis upon which this paper and the guidebook is presented. The guidebook, prepared under the auspices of the US Department of Energy, attempts to impart a comprehensive understanding of information important to the development of geothermal direct use projects. The text is aimed toward the engineer or technical person responsible for project design and development. The practical and technical nature of the guidebook answers questions most commonly asked in a wide range of topics including geology, exploration, well drilling, reservoir engineering, mechanical engineering, cost analysis, regulations, and environmental aspects. 6 refs., 2 figs., 4 tabs.

41888 Effects of steam/liquid counterflow on pressure-transient data from two-phase geothermal reservoirs. Bodvarsson, G.S. (9513035); Cox, B.L.; Ripperda, M. *SPE (Society of Petroleum Engineers) Reservoir Engineering (USA)*, 4(2): 187-193 (May 1989).

Numerical studies were performed to investigate the effects of localized feed zones on the pressure transients in two-phase reservoirs. Gravity effects were shown to affect the pressure transients significantly because of the large difference in the densities of liquid water and vapor. Production from such systems enhances steam/liquid-water counterflow and expands the vapor-dominated zone at the top of the reservoir. Subcooled liquid regions develop in the center of the reservoir as a result of gravity drainage of cooler liquid water. The vapor zone acts as a constant-pressure boundary and helps to stabilize the pressure decline in the system. The pressure transients at observation wells were shown to depend greatly on the location (depth) of the major feed zone; if this is not accounted for, large errors in deduced reservoir properties will result. At shallow observation points, pressures may actually increase as a result of enhanced steam upflow caused by production at a deep feed zone.

1510 Direct Energy Utilization

41889 (KWU-R–917/86/022) **Preparation of basic project design documents for advanced geothermal power plants. Final report.** Blanck, D. Kraftwerk Union A.G., Erlangen (Germany, F.R.). Gesamtanlagentechnik und Systemleittechnik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Dec 1986. 159p. (In German). Contract BMFT 03E-6176-A. Order Number DE89910947/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01.

The aim of this study is to create basic project design and planning documentation for geothermal power plants, thus rendering possible rational project work without requiring the exact data pertaining to any specific site. Components with a good service record in conventional power plants can be used in geothermal plants too, subject to certain adaptations called for by the special physical and chemical conditions encountered in such applications. Emissions can be reduced to internationally acceptable limits by associated mitigation equipment or procedures (such as treatment of the inert gases and the condensate, noise control measures). Raw material at prices that are competitive on the world market can be gained from the brine thanks to suitable procedures that have proven technically viable. (orig.) With 15 refs., 22 tabs., 79 figs.

41890 (PB–89-172241/XAB) **Auburn low-temperature geothermal well. Final report.** Lynch, R.S.; Castor, T.R. Donohue, Anstey and Morrill, Boston, MA (USA). Dec 1983. 268p. Available from NTIS, PC A12/MF A01.

See aiso DE86010654.

The Energy Authority, in conjunction with the U.S. Department of Energy, decided to test the applicability of utilizing geothermal heat in Cayuga County because of geologic conditions and geophysical evidence that there was adequate heat. A well site was chosen adjacent to Auburn Middle School and Cayuga County Community College. Both schools have potential for using recoverable heat. The well was drilled to 5,250 ft. (1 mile). The well heat temperature was around 120 - 124 F and analysis indicated the hot water could provide a major portion of the schools' hot water and space-heating needs. Estimates are that the well can supply heat to the schools for about ten years if the brine is reinjected after heat recovery. However, estimates of how long the supply of geothermal heat will last depends greatly on the accuracy of the reservoir-capacity estimate, and how effectively the reinjected brine maintains production well pressure. At present, an analysis is being made on the economic viability of geothermal projects.

1520 Geothermal Data and Theory

41891 Influence of heating mode in three-dimensional mantle convection. Bercovici, D. (Department of Earth and Space Sciences, University of California, Los Angeles (US)); Schubert, G.; Glatzmaier, G. A. *Geophysical Research Letters (USA)*, 16(7): 617-620 (Jul 1989).

Numerical models of three-dimensional, thermal convection in highly viscous spherical shells with different combinations of internal and basal heating consistently have upwelling concentrations in the form of cylindrical plumes and downwelling in planar sheets. As the proportion of internal heating increases, the number of upwelling plumes increases, and downwelling sheets become more vigorous and time-dependent. With any amount of basal heating, the entire convective pattern, during its evolution, is anchored to the upwelling plumes. As the proportion of internal heating increases, the heat flow carried by the upwelling plumes remains a large fraction of the basal heat flow. Downwelling sheets carry only a minor fraction (approximately 30%) of the basal heat flow (even when the shell is entirely heated from below), but they advect almost all of the internally generated heat. The relatively large number of plumes in the Earth's mantle (inferred from hotspots), the possibility that downwelling slabs are vigorous enough to penetrate the lower mantle,

and the small fraction of terrestrial surface heat flow carried by plumes all suggest that the mantle is predominantly heated from within. © American Geophysical Union 1989

17 WIND ENERGY

1701 Availability (climatology)

41892 (ETDE-mf–9911044) **Comparison of different wind classifiers.** Schneider, J.D.; Richter, B. Germanischer Lloyd, Hamburg (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Feb 1988. 46p. (In German). Contract BMFT 03E-8384-B. Order Number DE89911044/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01.

Five different wind classifiers from German manufacturers, which are suitable for autonomous operation in the field, have been tested and compared with the results from a reference device. In the last phase of the test a more elaborate wind-computer has also been investigated. This final report describes the course of investigation and the problems which occurred during the test. All classifiers had some weak points, leading to malfunctions and partial failures. But a total failure occurred only for one classifier. All the others could be repaired and were operational until the end of the test. Without these repairs though, none of the devices would have lasted for a nine month test-duration. In one classifier programming errors were detected by comparison with the reference device, which were corrected by the manufacturer. The wind-computer has had no malfunctions so far during the relatively short test period. The results of the comparison are presented in form of frequency distributions of wind velocities. After the test has been concluded, the measurements from the wind-classifiers will be compared with the reference device in predicting energy-output for a number of wind-turbines. These results will be published. (orig.) With 2 tabs., 18 figs.

1706 Wind Energy Engineering

Refer also to citation(s) 42306

41893 (DFVLR-Mitt.–88-06) **Development, construction and operation of a 30/100-kW wind energy converter (WEC).** Boehnisch, H.; Hald, H.; Kensche, C.; Kussmann, A.; Molly, J.P.; Seifert, H. Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.). 1988. 220p. (In German). Contract BMFT 03E-4439A. Order Number DE89911041/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; NTIS (US Sales Only), PC A10/MF A01.

The project 'Development, Construction and Operation of a 50/100 kW Wind Energy Converter (WEC)' was performed in a bilateral German/Brazilian cooperation between DFVLR and Centro Tecnico Aerospacial (CTA). Aim was to develop a light-weight WEC of 25 m rotor diameter which operates in low and medium average wind speeds. A built-in self erecting equipment allows to assemble the three-bladed WEC at remote areas. CTA manufactured the master piece of the rotor blade. From mid of 1983 the further project was done by DFVLR alone, since CTA left the project caused by financing problems. Extensive static and dynamic blade tests were performed to qualify the structural blade design. The assembly and erection on the DFVLR test site of the DEBRA-25 called WEC took place on July 13, 1984. Some improvements of the tower, hydraulic system and of the microprocessor-controlled operation supervisory were done during the test phase. After this the WEC went into continuous operation to a reference period of one year. The technical availability during that time was higher than 92%, the total energy harvest was 104 MWh in an average wind of only 4.2 m/s. On September 30, 1987 the WEC achieved 6395 hours of grid-connected operation and produced a total of 166 MWh electrical energy. (orig.) With 137 figs., 11 tabs., 39 refs.

41894 (ENEL-PV–16) **Wind energy: the Italian National Electricity Board's (ENEL) experience.** Casale, C.; Sesto, E. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Jan 1986. 13p. Order Number DE89761919/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

This paper reviews ENEL's activities and experimental plants in the context of its planned 500 kW demonstration wind power plant VELE. Details are given on the test station in Santa Caterina, Sardinia (two units, 68 and 15 kW), the conversion system of Alta Nurra, Sardinia (10 units, 50 kW each) and the plant in Salina, Eolie Islands (15 kW). For each of the stations indicated, information is provided on the aerogeneration configuration, plant design and performance. Also some comments are made on maintenance procedures.

41895 (ETDE-mf–9795589) **Status report on wind energy. Pt. 2. Wind power plants for developing countries - projects and manufacturers' specifications.** Tesch, F.; Gering, T. Deutsche Gesellschaft fuer Technische Zusammenarbeit G.m.b.H. (GTZ), Eschborn (Germany, F.R.). German Appropriate Technology Exchange (GATE). 1986. 116p. (In German). Order Number DE89795589/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01.

Part 2 of the status report 'Wind energy' gives information on selected project activities in developing countries as well as technical data and manufacturers' specifications. In Section A, the cooperation of the Federal Republic with developing countries in the area of wind energy use is described and details are given of projects in Haiti, Kenya and Peru. Section B describes the cooperation of selected donor countries (Netherlands, USA, Great Britain) with developing countries. Sections C and D contain the manufacturers' specifications for wind pumps and wind generators. (BR).

41896 (ETDE-mf–9795590) **Appropriate technology and land use planning. The example of a site suitability evaluation for irrigation with wind-pump systems in four cooperatives in the greenbelt of Maputo/Mozambique.** Technische Universitaet Berlin, Institut fuer Landschaftsoekonomie. Werkstattberichte. Baehring, A.; Wilker, I. Technische Univ. Berlin (Germany, F.R.). Inst. fuer Landschaftsoekonomie. 1986. 247p. (In German). Order Number DE89795590/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; NTIS (US Sales Only), PC A11/MF A01.

The knowledge accumulated from failed projects in international development cooperation makes clear the necessity of assessing not only economic analyses but also social and ecological factors when choosing and preparing the project. Within the study the irrigation potential in the sense of a lasting land use is examined and suitable areas for selected crops are identified. A social and economic investigation serves as a basis for the evaluation of an applied use of irrigation and wind-pump technology which is oriented to the needs and capacities of the later users. The FAO concept 'framework for land evaluation' underlies the methods used in the study. In order to resolve the complex problems at a detailed level of investigation, a system of work was specially developed to this end. (BR).

41897 (ETDE-mf–9795591) **Site study at Angonia in Mozambique. An investigative study to judge the potential for an irrigation agriculture with special consideration of the use of window-pump systems.** Technische Universitaet Berlin, Institut fuer Landschaftsoekonomie. Werkstattberichte. Amler, B. Technische Univ. Berlin (Germany, F.R.). Inst. fuer Landschaftsoekonomie. 1986. 138p. (In German). Order Number DE89795591/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; NTIS (US Sales Only), PC A07/MF A01.

This paper, a dissertation presented to the Department for Landscape Development at the Technical University in Berlin, is a site study of the district of Angonia (Mozambique), and aims at a general overview of the characteristics of this area and its specific problems. It is also meant to serve as a preliminary study for the possible use of wind-pump systems for the irrigation of small areas in this district, emphasizing particularly the problems and interrelated factors. For a lasting land-use plan, a comparison between an envisaged use and the natural and socio-economic aspects of a site is necessary. The study demonstrates such an evaluation procedure for an irrigation agriculture in an integrated approach. An unconventional procedure was thus developed for achieving reliable results in the shortest possible time and at reasonable cost. (BR).

41898 (ETDE-mf–9911035) **The operation of the large 3 MW wind turbine system, the GROWIAN. Final report.** Reinhold, H.; Scholz, J. Grosse Windenergieanlage Bau- und Betriebsgesellschaft m.b.H. (GROWIAN), Hamburg (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). May 1988. 49p. (In German). Contract BMFT 03E-8235-A. Order Number DE89911035/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01.

Following to the RD-Project 'Erection of the large wind energy plant GROWIAN', Project-No. 03E-4342-B, it is planned to put this plant into operation for 3 years. The test operation of the prototype unit primarily shall not serve the energy production but in the first place serve the collection of running experiences to establish a satisfactory operation of the plant's components and systems as well as their function ability and safety. Set aim: The results and expenditure, including knowledge received by the erection of the plant, shall be a standard for the realization and efficiency of current generation by large wind energy plants. Result: The test operation has fully confirmed the overall function of the plant's concept and the executed constructions. The characteristics expected by the rotor, transmission and generator as well as by the auxiliaries and control systems have been fulfilled. Performance and especially the aerodynamic rotor behavior corresponded well with the planned standards. During critical running stages the plant's reactions have at any time been controlled by the safety and protection system. (orig.) With 12 refs., 9 figs.

41899 (ETDE-mf–9911074) **Measurements at the wind energy converter Ruhrtal R 1550. Final report.** Germanischer Lloyd. Bericht. Meier, H. Germanischer Lloyd, Hamburg (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Apr 1989. 179p. (In German). Contract BMFT 03E-8384-A. Order Number DE89911074/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; NTIS (US Sales Only), PC A09/MF A01.

It is one of the goals of the research project 'Evaluation of Rules for the Examination, Approval and Inspection of Wind Energy Coverters (WEC); Measurement on WECs' to establish a data base for reliable load assumptions by measurements in field, of various types of WECs. This interim report deals with measurements at a commercially used 65 kW horizontal-axis WEC with 3 fixed pitch blades. The data evaluation is not completed, but storage of interim results allow for a continuation at due time. In their present form, the results confirm the design parameter and do not conclude any potential irregularities for future operation. (orig.) With 2 refs., 3 tabs., 8 figs.

41900 (ETDE-mf–9911076) **3 MW GROWIAN wind turbine test program. Final report.** Koerber, F.; Besel, G.; Reinhold, H. Grosse Windenergieanlage Bau- und Betriebsgesellschaft m.b.H. (GROWIAN), Hamburg (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). May 1988. 221p. (In German). Contract BMFT 03E-4512-A. Order Number DE89911076/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; NTIS (US Sales Only), PC A10/MF A01.

In the costal area of the Federal Republic of Germany a test program was performed on the 3 MW wind turbine GROWIAN in 1983 to 87. The object of the activities was to identify the performance of the turbine and improve the understanding of wind turbine technology. The results deal with wind field characteristics in the free stream and in the wake of the turbine and their effect on the turbine performance and power quality. Vibration behaviour is evaluated concerning eigenfrequencies and structural response on wind and machine excitations. The load measurements are analyzed for the rotor blades and the tower. The problems of overload in the hub and repair measures are discussed. The performance of the electrical system and the operation control strategy is compared with the planning. Finally the report notes the environmental impact of the wind turbine concerning noise and television interference. (orig.) With 13 refs., 117 figs.

41901 (ETDE-mf–9911077) **The construction of the large 3 MW wind turbine system, the GROWIAN. Final report.** Endres, A.; Reinhold, H.; Scholz, J. Grosse Windenergieanlage Bau- und Betriebsgesellschaft m.b.H. (GROWIAN), Hamburg (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Mar 1988. 195p. (In German). Contract BMFT 03E-4342-B. Order Number DE89911077/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A09/MF A01.

Knowledge and experience gained nationally and internationally uptodate, concerning wind energy conversion devices of small and medium capacities, as well as the results of various R and D efforts previous to the project GROWIAN, have indicated that a large-scale attempt for an additive electric power generation through wind energy conversion of a 2000 kW - 3000 kW capacity is realizable. Thus it was respectively decided to realize the project GROWIAN by means of a prototype device despite the fact that, with such required dimensions as - tower height 100 m/rotor diameter 100 m/ nominal capacity 3000 kW - such a conversion scale had no precedent and hence implied venturing into technical new land. Set aim: Projection, construction, installment and testing should be undertaken for the realization of the specific development of device components and systems. Respectively gained experience should enable, besides the determination of construction expenses, also the evaluation of the realization and economy of electric power generation concerning large wind turbine systems. Result: Apart from the question of durability and that of the determined construction expenses, the device had fullfilled its designated role. (orig.) With 36 refs., 6 tabs., 43 figs.

41902 (ETDE-mf–9911274) **Perspectives of wind power supply in the Federal Republic of Germany. Strategy study.** Molly, J.P.; Schott, T.; Schmidt-Kuester, W.J.; Tegen, W. Foerdergemeinschaft Windenergie e.V., Kiel (Germany, F.R.). Jul 1988. 108p. (In German). Order Number DE89911274/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01.

Wind energy conversion is by far the most efficient of the technologies utilizing renewable energy sources. In some cases, it can even compete with conventional energy sources. The report discusses the potential of wind power in West Germany and Europe. International wind power programmes and the development of the technology are presented. One section of the report focuses on the market for wind power plants and on the practice of wind power plant testing and licensing in Germany's federal states. The industrial and ecological boundary conditions and the resulting political discussion in the Federal Republic of Germany are gone into. Finally, the report presents examples of state funding of wind power projects and recommendations for the development of the wind power technology, the integration of wind power in the national energy policy, aspects of the state funding policy, and joint venture wind power projects in cooperation with developing countries. (BR).

41903 (IREQ–7403, pp. 9) **Electrical energy storage at the Magdalen Islands.** Royet, J. (Inst. de recherche de l'Hydro-Quebec, PQ, Canada). Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). 1974. (In French). (CONF-7403113–: Stockage de l'energie, Varennes (Canada), 20 Mar 1974; CE–02476). In *Symposium. Energy storage.* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This paper discusses wind energy storage. Electrical diagrams of power systems with battery or cavern storage are presented. A possible first step in creating a practical system would be to make available diesel power to face peak loads. Next would be the installation of several windmills around each reserve, the capacity of existing windmills being 150 kW at most. The reserve could comprise one or more units. Models of compressors and air motors are discussed. 6 figs.

41904 (NRC–27582) **Performance of the Holyrood I 50kW VAWT [vertical axis wind turbine], June 1978 to September 1981. Technical memorandum.** Rangi, R.S. National Research Council of Canada, Ottawa, ON (Canada). 1986. 34p. (MICROLOG–87-04602). Available from National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, ON, CAN K1A 0R6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A prototype 50 kW vertical axis wind turbine was installed near Holyrood, Newfoundland, in June 1978 and operated for almost

three years. The turbine produced 21,600 kWh of net energy in 3015 generating hours. The availability of the turbine during the evaluation period (January 1979-May 1981) was approximately 40%. The poor availability was primarily due to malfunction of small components and subsequent delays in maintenance, repair, or replacement. The turbine was dismantled in November 1981 and shipped to Ottawa for non-destructive inspection. The inspection revealed little in the way of major structural damage. A second updated machine was installed at the site in April 1982. 3 refs., 5 figs., 3 tabs.

41905 **Mean and peak wind loads on heliostats.** Peterka, J.A. (9511571); Tan, Z.; Cermak, J.E.; Bienkiewicz, B. *Journal of Solar Energy Engineering (USA)*, 111(2): 158-164 (May 1989).

Mean and peak wind loads on flat rectangular or circular heliostats were measured on models in a boundary layer wind tunnel which included an atmospheric surface layer simulation. Horizontal and vertical forces, moments about horizontal axes at the ground level and at the centerline of the heliostat, and the moment about the vertical axis through the heliostat center were measured. Results showed that loads are higher than predicted from results obtained in a uniform, low-turbulence flow due to the presence of turbulence. Reduced wind loads were demonstrated for heliostats within a field of heliostats and upper bound curves were developed to provide preliminary design coefficients.

20 ELECTRIC POWER ENGINEERING

Refer also to citation(s) 41504

41906 (EPRI-GS–6430) **Specifications for a plant electrical systems and equipment workstation: Final report.** McCauley, T.M.; Bramwell, M.L.; Merkel, A.C.; Tracy, J.F. Electric Power Research Inst., Palo Alto, CA (USA); Sargent and Lundy, Chicago, IL (USA). c Aug 1989. 53p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Electric Power Research Institute (EPRI) authorized Project RP 2960-1 for the development of functional specifications for a Plant Electrical Systems and equipment (PESE) Workstation. The objectives for the PESE Workstation is to enhance a utility's in-house capabilities to attain higher overall equipment and system reliability. The workstation will be a software and data management environment whose purpose is to integrate current and anticipated software and associated databases. Utility needs in the electrical engineering area and the related functions required to support these needs were derived from a survey of EPRI utilities and the experiences of the project team. The workstations scope and information structure are described in terms of the activities and data elements of the EPRI Plant Information Network (PIN). Ten major application software modules are included in the workstation. Appropriate hardware configurations have been determined based on the software, user interface, and database requirements. Important features of the workstations include: (1) a common, consistent interface between the user and the workstation's application software modules, query facility, and telecommunications facility, and (2) a common, shared database as the coordination point for work activities supported by the workstation. Full implementation of the workstation will occur in phases. Utility interest in the workstation concept is expected to increase due to greater NRC and INPO requirements for enhanced data management and maintenance of plant design bases. 2 figs., 5 tabs.

2001 Power Plants and Power Generation

Refer also to citation(s) 41483, 41798, 41903, 41944, 42173, 42174, 42175, 42176, 42177, 42202, 43035

41907 (DOE/MC/21023–2717) **Second-generation pressurized fluidized bed combustion plant: Phase 2 technical progress report, April–September 1988.** Robertson, A. Foster Wheeler Development Corp., Livingston, NJ (USA). Oct 1988. 50p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-86MC21023. Order Number DE89011671/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

After many years of experimental testing and development work, coal-fired pressurized fluidized bed (PFB) combustion combined-cycle power plants are moving toward reality. Under the US Department of Energy's Clean Coal Technology Program, a 70-MWe PFB combustion retrofit, utilizing a 1525°F gas turbine inlet temperature, is to be built as a demonstration plant at the American Electric Power Company's Tidd Plant in Brilliant, Ohio. The targeted goals are a 45-percent efficiency and a cost of electricity (COE) that is at least 20 percent lower than the COE of a conventional pulverized-coal (PC)-fired plant with stack gas scrubbing. In addition, plant emissions should be within New Source Performance Standards (NSPS) and the plant should have high availability, be able to burn different ranks of coal, and incorporate modular construction technologies. The program is structured into three phases. During Phase 1, the system was defined and optimized. The major thrust of Phase 2 is to design, construct, test, and evaluate the performance of the key components of the proposed plant, (i.e., carbonizer, CPFBC, ceramic cross-flow filter, and multiannular swirl burner (MASB) topping combustor), all as separate components. In Phase 3 these key components will be designed, constructed, and tested at a 5-MWe (equivalent) scale as a fully integrated subsystem. This effort will allow component performance data to be collected on a larger scale and, most important, integrated subsystem performance data obtained and proposed plant operating modes/philosophies investigated. In Phases 2 and 3, the commercial/baseline plant design and R and D program plan prepared in Phase 1 will be updated to reflect the results of Phases 2 and 3 testing. This report discusses Phase 2. 20 figs., 6 tabs.

41908 (DOE/MC/21023–2718) **Second-generation pressurized fluidized bed combustion plant research and development needs, Phase 1, Task 2: Topical report.** Robertson, A.; Garland, R.; Newby, R.; Rehmat, A.; Rubow, L. Foster Wheeler Development Corp., Livingston, NJ (USA). Mar 1989. 55p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-86MC21023. Order Number DE89011672/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report identifies, classifies, and ranks the research and development needs of coal-fired second-generation pressurized fluidized bed combustion plants. This type of plant can operate with a 45-percent efficiency (based on the higher heating value of the coal used as fuel) and can achieve a cost of electricity at least 20-percent lower than that of a conventional pulverized-coal-fired plant with wet-lime-stone flue gas desulfurization. The proposed plant concept integrates a coal pyrolyzer/carbonizer with a circulating pressurized fluidized bed combustor (CPFBC). Char produced in the carbonizer is burned in the CPFBC, and the low-Btu fuel gas produced in the carbonizer is burned in a topping combustor to heat the CPFBC exhaust gas to 2100°F and higher before it enters a gas turbine. The carbonizer and CPFBC operate with lime-based sorbents for in-situ sulfur capture at $\leq$1600°F. Components being developed for first-generation pressurized fluidized bed combustion plants (gas turbine inlet temperature $\leq$1600°F) protect the gas turbine from corrosion, erosion, and deposition. 14 refs., 15 figs., 6 tabs.

41909 (ENEL-SI–755-86) **Determination of mathematical models for shallow water design waves.** Lamberti, A.; Toffolo, F. Bologna Univ. (Italy); Ente Nazionale per l'Energia Elettrica, Milan (Italy). Mar 1986. 47p. (In Italian). Order Number DE89761914/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report describes the procedure for the determination of the marine climatic conditions and design wave for the site of the thermal power plant of Fiume Santo (Porto Torres, Sardinia). The procedure consists of three steps: (1) the reconstruction of the bidimensional off-shore wave spectra for different wind intensities; (2) the use of the inverse spectal refraction method to transfer wave effects to the shore; (3) a statistical analysis (stratified type) of the values of the modeled wave effects. In the use of this procedure for wave modeling, it was noted that the consolidation of the variableness of real situations into a single significant situation, as defined by the above three steps, results in a significant underestimation of

maximum wave height as compared with values obtained by observation.

41910 (EPRI-CS–5395, pp. 5.41-5.54) **Acoustic boiler leak detection systems.** Litt, R.D. (Battelle Memorial Institute, Columbus, OH (USA)); Scheibel, J.R.; Snow, D.J. Electric Power Research Inst., Palo Alto, CA (USA); Liberty Technology Center, Inc., Conshohocken, PA (USA). Aug 1988. (CONF-8703283–: 3. EPRI incipient-failure detection conference, Philadelphia, PA (USA), 10-12 Mar 1987). In *Third EPRI incipient-failure detection conference: Proceedings.* Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A summary of US utility experience with acoustic boiler leak detection systems is presented. The Electric Power Research Institute (EPRI) is conducting a program to evaluate the performance, usefulness, benefits, and acceptance of the available systems in the initial US installations. The various systems are described as well as how they are used. The present study includes 12 US utility boilers with 162 channels of acoustic leak detection equipment. The types of boilers and sensor locations vary with the installation but represent most situations of interest. Examples of results, general conclusions, and recommendations from the study are discussed. Information is also provided about the current status of acoustic leak detection systems that have been used for over 10 years by the Central Electricity Generating Board (CEGB) in the U.K.

41911 (ETDE-mf–9795594) **Operational tests of the innovative components in the prototype power plant Voelklingen - fluidized-bed combustion and hot air gas turbine - and research of their reciprocal influences. Final report.** Scholl, G.; Stadie, L. Saarbergwerke A.G., Saarbruecken (Germany, F.R.). Produktbereich Kraftwerke; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1987. 304p. (In German). Contract BMFT 03E1065D. Order Number DE89795594/JAW. Available from NTIS (US Sales Only), PC A14/MF A01; NTIS (US Sales Only), PC A14/MF A01.

By the combination of a steam generator with the innovative components fluidized-bed combustion and hot air gas turbine in the prototype power plant Voelklingen (230 MW) for the first time a hard coal based combined cycle is realized. By the additional heat extraction for district heating and the discharge of the desulfurized flue gas via a cooling tower in this power plant all essential approaches for an innovative hard coal power plant known at the disigning time are included. During several years of research the innovative components fluidized-bed combustion and hot air gas turbine were investigated in order to test and optimize the components with regard to their availability, operation characteristics and reciprocal influences and to find out their pollutant emissions. Essential results: The combination of the fluidized-bed combustion with the steam generator within the prototype power plant process lead to the realisation of a two stage combustion. The better and more determined combustion allowes the low polluting burning of coal with high ash content, an essential reduction of NO_x-emissions. The integration of the hot air gas turbine into the power plant process as a combustion air supply-system for steam generator and fluidized-bed combustion as well as their application as a hot air turbine on coal based heat have been prooved good. Therefore an improvement of the net efficiency of the power plant and a reduction of the NO_x-emissions of the power plant flue gas could be reached. The innovative components fluidized-bed combustion and hot air gas turbine are reliable in service and do not at all influence the availability of the power plant. Investigations on the erosion rate at the fluidized-bed combustion heating surface system are going on. (orig.) With 16 refs., 9 tabs., 93 figs.

41912 (ETDE-mf–9795595) **Operational tests of the first purely coal based combined cycle power plant - prototype power plant Voelklingen. Final report.** Scholl, G.; Stadie, L. Saarbergwerke A.G., Saarbruecken (Germany, F.R.). Produktbereich Kraftwerke; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1987. 410p. (In German). Contract BMFT 03 E 1065 B. Order Number DE89795595/JAW. Available from NTIS (US Sales Only), PC A18/MF A01; NTIS (US Sales Only), PC A18/MF A01.

By the combination of a steam generator with the innovative components fluidized-bed combustion (FBC) and hot air gas-turbine in the prototype power plant Voelklingen (230 MW) for the first time a hard coal based combined cycle is realized. By the additional heat exctraction for district heating and the discharge of the desulfurized flue gas via a cooling tower in this power plant all essential approaches for an innovative hard coal power plant known at the designing time are included. During several years of research this power plant process was intensively investigated. Moreover new software was established for the control systems, introduced for the first time in such a plant, in order to test and optimize the innovative technologies with regard to operational characteristics, failure reaction, efficiency, economy, and reduction of the pollutant emissions. Essential results: high flexibility of the power plant either to the dynamic characteristics (change of power, start up and shut down) or to the range of load according to use of the combustion components FBC, hot air gas-turbine, steam generator; low pollutant emissions, especially NO_x, mainly as the result of the two stage-combustion with its thermic aftertreatment of the FBC's flue gas in the steam generator; proof of the control-systems for instance concerning, transfer of the research results into the power plant, operational security and reliability of the plant, supervising of the process, use and handling the plant: for instance establishing computer software for optimal power distribution to gas turbine, FBC and steam generator in order to minimize the operational cost (fuel) and the emission of pollutants and for operating the plant considering its best efficiency. (orig.) With 14 refs., 13 tabs., 126 figs.

41913 (IREQ–7403, pp. 17) **Storage needs in Hydro-Quebec's equipments program.** Dupuis, F. (Inst. de recherche de l'Hydro-Quebec, PQ, Canada). Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). 1974. (In French). (CONF-7403113–: Stockage de l'energie, Varennes (Canada), 20 Mar 1974; CE–02476). In *Symposium. Energy storage.* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This paper discusses the choice of production equipment at Hydro-Quebec through the CAPRI (calculation of investment projects) model; this applies, in particular, to storage projects. The various techniques of storing energy are compared in the cases of large and small amounts. From 1980 on, 1000 additional MW of peak load equipment per five years will be needed and this rate will increase in the future. In Quebec, there are more than 50 small grids, including the Magdalen Islands grids, in which wind energy could be used in conjunction with energy storage. Storage is not an intrinsic need of electrical energy production. However, Hydro-Quebec is looking for peak load equipment with an investment cost as small as possible; pumped reserves could be competitive with gas turbines in this respect. 9 figs.

41914 (NEI-NO–87 G1 62) **Use of natural gas in power generation in IEA countries.** Jones, D. (International Energy Agency). Norsk Petroleumsforening, Oslo (Norway). 1988. (CONF-8808151–: Offshore northern seas conference and exhibition, 23-26 Aug 1988). In *Gas utilization.* Order Number DE89776213/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The electricity supply industry in IEA countries is going through a period of change. There is a move away from traditional centralised electricity generation towards more decentralised forms of supply. In some, although not all countries, competition is beginning to appear in what had traditionally been seen as a natural monopoly. New generating technologies are coming forward. New considerations, particularly concerns about the environemnt, are increasingly important for energy descisions. These changing circumstances inevitably influence the pattern of fuel use in electricity generation. They create opportunities for increased penetration of the electricity generating market by gas, particularly in Europe. Wether these opportunities are realized, will turn largely on the availability of secure supplies of gas from a range of sources and at competitive prices. It will be the task of the industry to secure such supplies. It will be the task of the Government to provide a framework of policy which takes into account the wider considerations such as energy security and environmental policy which are relevant, but otherwise provides a basis for achieving the most efficient and economic balance between the different sources of primary energy. The results of this approach may well vary with national and utility circumstances, but

at the least some greater role for gas in electricity generation seems likely in the 1990s and beyond. 9 figs., 6 tabs.

41915 (NEI-NO–87 G4 10) **Natural gas in power plants combines with district heating.** Ihamuotila, J. (Neste Oy, (Finland)). Norsk Petroleumsforening, Oslo (Norway). 1988. (CONF-8808151–: Offshore northern seas conference and exhibition, 23-26 Aug 1988). In *Gas utilization.* Order Number DE89776213/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Because of the technical potential and competitiveness of natural gas, several gas-based power plants are being either built or projected along the Finnish natural gas network. It is believed that combined power and heat production will double natural gas consumption in Finland by the end of the next decade. In the late 90's when the interscandinavian gas grid has been built, gas in electricity production and more specifically in combined power and heat production will be one essential part of gas consumption in Scandinavia. Especially in Finland and Sweden the existence of district heating systems will enable large scale use of gas in cogeneration power plants. In Finland gas based condensing power plants may have taken their position in the electricity generation system. In total the future use of gas for power generation is promising.

41916 (NEI-NO–87 G5 14) **Introduction of power generation based on natural gas into a highly developed hydro power system. Case study.** Haga, I. (Statkraft, Oslo, (Norway)). Norsk Petroleumsforening, Oslo (Norway). 1988. (CONF-8808151–: Offshore northern seas conference and exhibition, 23-26 Aug 1988). In *Gas utilization.* Order Number DE89776213/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The demand for electric power in Norway has till now almost entirely been met by developing the country's hydro power resources. The present annual production is slightly over 100 TWh. A further 40TWh annual production capacaties could still be developed. However, both the costs of developing these resources and the desire to preserve undisturbed nature would reduce the practical potential. The magnitude of the gas resources and developments in gas pipe laying techniques both contribute to a situation where land based gas fired power plants could be considered as a supplement to the hydro power system. In a report on future electricity supply and demand, which was presented by the Government one and a half year ago, gas fired power plants were expected to cover most of the increase in demand up to the year 2000. It was suggested that the increase in demand for electricity would require that the first large plant should be in operation early in the nineties. This was the basis for starting detailed planning of a 700 MW(e) unit at the Norwegian west cost. A secures gas supply for 25 yars with reasonably predictable prices made the choice of an unfired combined cycle power plant obvious. This plant type offers the advantages of a short construction period, low investment and high efficiencies. The production capacity of the Norwegian hydro power system varies from one year to the other, depending on the amount of precipitation. This may be illustrated by showing the production capacities based on statistics for precipitation e.g. in the period 1920-50. The contribution of the gas turbine plant in the power system is established through total system simulations with varying running costs of the plant. 6 figs.

41917 (OH/CR–88-158-K) **Lambton TGS [thermal generating station] chimney 2. Condition survey of concrete shell.** McColm, E.J. Ontario Hydro, Toronto, ON (Canada). Civil Research Dept. 1988. 18p. (MICROLOG–89-02538). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An inspection of the concrete shell of the Lambton Thermal Generating Station Chimney #2 was conducted in May 1988, as part of the life assessment program. On the exterior of the shell, five main cracks were identified, having a maximum crack width of 0.020". Based on observations of the interior surface of the shell, some of these cracks may extend through the thickness of the concrete along a portion of their length. At the base of the shell, in the annular space, the concrete has been attacked by an acidic mixture of fly ash and water that accumulates in this area. 19 figs., 1 tab.

41918 (OH/RD–88-77-K) **Off-rotor weld repairs to Nanticoke TGS [Thermal Generating Station] low pressure turbine blades.** Galloway, J.G. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 14p. (MICROLOG–89-02547). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Leading edge cracking on martensitic stainless steel low pressure turbine blades has been repaired, off-rotor, with the gas tungsten-arc welding process. This report describes the step-by-step details of the repair procedure, and the results of a metallurgical and mechanical evaluation of the effects of the repair on overall blade integrity. Although it is believed that these repaired blades would not yet be suitable for use in production, the information gained from this work is one step towards the eventual development of an in-situ or on-rotor repair welding technique. 10 refs., 9 figs., 4 tabs.

41919 (PB–89-861785/XAB) **Boiler and steam-generator corrosion. January 1970-May 1989 (Citations from the NTIS data base). Report for January 1970-May 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 169p. Available from NTISPC N01/MF N01.

Supersedes PB–88-860333.

This bibliography contains citations concerning corrosion effects, mechanisms, detection, and inhibition in fossil-fuel fired boilers and nuclear-powered steam generators. Corrosion studies performed on the water side and hot gas side of heat exchanger tubes and support structures are presented. Water treatment, chemical cleaning, and descaling methods are considered. Although emphasis is placed on large-scale power generation systems, residential and commercial heating systems are also discussed. (This updated bibliography contains 308 citations, 20 of which are new entries to the previous edition.)

41920 (VTT-TUTK–587) **Creep damage analysis of an old steam piping by using the replica technique.** Salonen, J.; Vierros, P. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Feb 1989. 56p. (In Finnish). Order Number DE89902335/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The replica technique, based on the metallographic analysis of grain boundary cavities caused by creep, has become a widely used method in investigating the condition of creep loaded power plant components and in estimating their residual life limited by creep damage during the recent years. The technical limitations of this method are the limited size of the inspected area and the inspection of the material near the outer surface only. In order to clarify and eliminate the uncertainties caused by these limitations, the distribution of the creep damage in old power plant components was investigated. To improve the reliability and the accuracy of minimum residual life time estimations the results of reinspections made so far were also collected in this report. Moreover, to evaluate the general reliability and reproducibility of the technique, results of a Eurotest round robin programme have been reviewed in the report.

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Refer also to citation(s) 41455, 41456, 41457, 41458, 41459, 41460, 41461, 41466, 41494, 41798, 41908, 41911, 41912, 42284, 43381, 43420, 43510

41921 (AERE-R–13110) **Optimisation by simulated annealing and an optimal strategy for retrofit flue gas desulphurisation in the United Kingdom.** Derwent, R.G. UKAEA Harwell Lab. (UK). Environmental and Medical Science Div. Apr 1988. 16p. Available from United Kingdom Atomic Energy Authority, Harwell. Environmental and Medical Sciences Division.

The design of an optimal strategy for the retrofitting of United Kingdom coal-fired power stations with flue gas desulphurisation has been studied as an illustrative application of the techniques of optimisation by simulated annealing. In this way, it has been possible to rank power stations in order so that if they were retrofitted with FGD, maximum environmental benefit in terms of reduced sulphur deposition in the most sensitive regions could be achieved.

41922 (DOE/PC/88867–T3) **Electrostatic precipitation of condensed acid mist: Third quarterly technical progress report, March 1–May 31, 1989.** Southern Research Inst., Birmingham, AL (USA). 1989. 14p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88867. Order Number DE89015764/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Acid mists can sometimes constitute a significant portion of the total particulate emissions from power plants burning high-sulfur coals. A wet electrostatic precipitator (WESP) is the best control option for acid mist. The mist would blind a fabric filter and attack glass fiber fabrics. A wet ESP is required because the acid would quickly corrode the plates in a conventional dry ESP. The wet ESP also offers the advantages of no rapping reentrainment and no sensitivity to fly ash resistivity. The project is organized in two phases. Phase I, which is scheduled for September 1988 to September 1989, involves the WESP fabrication, laboratory and pilot combustor testing, and computer modeling. Phase II, which is scheduled for September 1989 to September 1990, involves the solicitation of a utility demonstration site, preliminary site measurements, and planning for the demonstration test program. Progress on Phase I work is addressed in this discussion. 5 refs., 4 figs.

41923 (EPRI-GS–6423-Vol.2) **1989 symposium on stationary combustion nitrogen oxide control: Volume 2.** Electric Power Research Inst., Palo Alto, CA (USA); Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab. c Jul 1989. 547p. Sponsored by Electric Power Research Institute. (CONF-890318–Vol.2: Joint symposium on stationary combustion nitrogen oxide control, 6-9 Mar 1989). Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The 1989 Joint Symposium on Stationary Combustion NO_x Control was held in San Francisco, California, March 6–9, 1989. This Symposium, jointly sponsored by EPRI and EPA, has as its objective the exchange of information regarding recent technological and regulatory developments pertaining to stationary combustion NO_x control in the United States and abroad. Topics covered during the Symposium included: low-NO_x combustion development; coal-, oil-, and gas-fired boiler applications; flue gas treatment; fundamental combustion studies; and environmental and regulatory issues. The Symposium Proceedings is published in two volumes. Individual projects are processes separately for the data bases.

41924 (EPRI-GS–6464) **Corrosion inhibitors for SO_2 scrubber outlet ducts: Final report.** Phull, B.S. Electric Power Research Inst., Palo Alto, CA (USA). c Jul 1989. 234p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Baseline (inhibitor-free) corrosion data were obtained on 1020 carbon steel, Types 316L and 317L stainless steels, and alloys G-3 and 625, in the outlet duct of the model SO_2 scrubber. The effect of mounting replicate test specimens of each alloy at 0, 8 and 16 mm from the scrubber wall, on their corrosion behavior, was also investigated in one of the baseline runs. In separate runs, the influence on corrosion behavior of spraying water, an alkaline solution, and a 0.1% solution of a commercial inhibitor (Cronox-806) was investigated. The objectives of the water and alkaline spray tests were to determine the roles played by water and pH respectively, in mitigating corrosion in the final run of the study (Phase 1), where a 0.1% solution of Na_2HPO_4 had been sprayed in the outlet duct. Further evaluation of the Cronox-806 inhibitor was based on dramatic inhibition obtained from alloy G-3 in a screening test in the previous (Phase 1) study. Corrosion potential and polarization resistance measurements were performed intermittently on separate electrodes of the five alloys, exposed in the outlet duct, during each test run. 24 refs., 45 figs., 8 tabs.

41925 (ETDE-mf–9795596) **Emissions and dispersal measurements at the flue gas-/cooling air discharge system of the prototype power plant Voelklingen. Final report.** Petzel, H.K.; Koenig, F.J. Saarbergwerke A.G., Saarbruecken (Germany, F.R.). Produktbereich Kraftwerke; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1987. 115p. (In German). Contract BMFT 03 E 1065 C. Order Number DE89795596/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01.

During wet flue gas desulfurization the flue gas temperature becomes so low that the treated flue gas has to be reheated for discharging via a power plant stack. Prototype power plant Voelklingen practices for the first time the discharge of desulfurized flue gas via a cooling tower. The effectiveness of this discharge and the emission situation was tested by measurements under different weather and load conditions. The advantage of a cooling tower discharge is better updraft flow and lower immission in the vicinity, penetration of inversion weather layer, reduction of investment and operation cost by avoiding the reheating of desulfurized flue gas. The results gained at the prototype power plant Voelklingen can be transferred to other power plants. (orig.) With 1 ref., 5 tabs., 81 figs.

41926 (LIS–86) **Uses of ammonia water in catalytic DeNOx-plants. Investigation results from a pilot plant.** Katzer, H.; John, R. Landesanstalt fuer Immissionsschutz des Landes Nordrhein-Westfalen, Essen (Germany, F.R.). 1989. 51p. (In German). Order Number DE89911268/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A04/MF A01.

Ammonia is stored in power plants in pressurized liquid phase and used in gaseous phase for flue gas denitrification. Power plants, for which storage of ammonia in pressure liquefied phase poses problems, storage and use of ammonia water provide a safe alternative. The current report describes experiments with ammonia water for the catalytic removal of oxides of nitrogen from dust ladden flue gases of a coal-fired power plant. Ammonia water was used instead of the usually applied gaseous ammonia. The experiments were the first of this kind. With ammonia water the same removal efficiency was achieved as with gaseous ammonia. Complete evaporization of the ammonia water is a prerequisite for achieving this result. (orig.).

41927 (OH/CR–88-202-K) **Benchscale studies of limestone calcination and sulfation. TGA [thermal gravimetric analyzer] humidification studies.** Kalvins, A.; Handy, B. Ontario Hydro, Toronto, ON (Canada). Chemical Research Dept. 1988. 26p. (MICROLOG–89-02545). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report presents the results of a bench scale study of the effect of in-duct humidification of furnace-injected limestone-based sorbents on additional SO^2 removal. Four levels of relative humidity, 0, 27, 56, and 77% RH at 70^{0}C, and temperatures in the range of 80-1000^{0}C were studied. Two high calcium limestones, Beachville and Pt. Anne, the dolomite King, and Beachville hydrated lime were tested. At temperatures below about 350^{0}C and above 600^{0}C humidification was not found to improve the rate or extent of additional SO^2 capture by the partially sulfated sorbents. At temperatures between 400 and 600^{0}C, some improvement in SO^2 removal was observed with humidification. Results suggest that the presence of liquid water is essential for the enhancement of SO^2 removal by partially sulfated sorbents at the low temperatures encountered in the furnace duct. 10 refs., 9 figs., 2 tabs.

41928 (OH/RD–88-63-K) **Sorbent injection for SO_2 control.** Mozes, M.S.; Mangal, R.; Thampi, R.; Tubman, D. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 52p. (MICROLOG–89-02548). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Sulfur capture by in-furnace injection of calcium-based sorbents has been studied at Ontario Hydro's 640 MJ/h combustion research facility under conditions simulating full scale operation. The study is aimed at quantifying the effects of process parameters on SO^2 capture, sorbent utilization, waste characteristics, and electrostatic precipitator (ESP) performance. Sorbent types tested include: two calcitic limestones, a hydrated lime, and a dolomite. Injection temperature, residence time, sorbent addition rate, and particle size have been optimized to maximize SO^2 capture and sorbent utilization and to minimize the impact on particulate removal by the ESP. Under optimized operating conditions, while burning a 1.7% S bituminous coal, up to 43% SO^2 can be removed from flue gases using a nonporous, 56% using a porous calcitic limestone, 63% using a hydrated lime and 51% using a domomite, in good agreement with

full scale test results. The resulting waste is finer than the ash alone. The solids loading is about 200% greater with sorbent injection, and ash resistivities are up to three to four orders of magnitude higher than that of the coal ash. ESP performance deteriorated by about 2 to 16% in efficiency depending on the sorbent used. Humidification of sorbent injection waste upstream of the electrostatic precipitator enhanced SO^2 capture by about 6% for hydrated lime, 18% for limestone, and 7% for dolomite injection, bringing the total SO^2 capture to 67%, 61%, and 51% respectively. Humidification reduced the resistivity of the waste from about 10^{11}-10^{12} to 10^8 ohm.cm, and improved the efficiency of the ESP. 21 refs., 15 figs., 10 tabs.

41929 (OH/RD–88-134-K) **Sidney generating systems earth resistivity measurements.** Pillai, P. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 11p. (MICROLOG–89-02558). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Earth resistivity tests were conducted at the Sidney Generating Station/Transforming Station site using the Wenner method. The results indicated a multi-layer earth structure at the site. A two-layer interpretation of the test data provided an adequate model for use in design calculations. 1 ref., 5 figs., 5 tabs.

41930 (PB–89-169841/XAB) **Humidification of flue gas to augment SO_2 capture by dry sorbents. Reppri for October 1985-July 1988 (Final).** Gooch, J.P.; Beittel, R.; Dimukes, E.B.; Dahlin, R.S. Southern Research Inst., Birmingham, AL (USA). Mar 1989. 76p. (SRI-ENV–88-1023-5914). Available from NTIS, PC A05/MF A01.

This report discusses, for a coal-burning power plant, using humidification of the flue gas in a low-temperature duct to increase SO_2 removal by dry calcium-based sorbents. In particular, humidification may be a desirable modification of EPA's LIMB process, which is based on injecting limestone or hydrated lime in the furnace; it could augment SO_2 removal by adding post-furnace removal to that occurring in the injection zone. The report covers work in post-furnace humidification, charge-augmented humidification, water vapor adsorption by lime (with and without additives), and mathematical modeling of humidification and SO_2 removal processes. From these investigations, it was concluded that, for enhancement of SO_2 capture at the Edgewater demonstration of LIMB, humidification by a water spray will be required. A spray of pure water would suffice if the frequency of collisions between sorbent particles and water droplets could be increased. Deliquescent additives that are known to enhance SO_2 capture by $Ca(OH)_2$ at low temperatures must operate to some extent by mechanisms other than deliquescence.

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Refer also to citation(s) 42593

41931 (BCH/RD–030-D-173-Prt2) **Ageing evaluation of XLPE cable inference from accelerated life tests and the effects of water trees.** Abdollal, K.; Orton, H.E. British Columbia Hydro, Vancouver, BC (Canada). Research and Development. 1987. vp. (CE–02638). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report presents the results of an investigation into the effects of water on the longevity and performance of cross linked polyethylene (XLPE) cable. Ac breakdown tests were carried out on service aged cables and on cables aged in the laboratory under accelerated conditions. This was followed by a water tree count and a microscopic examination of the failure sites to determine possible causes of failure. The ac breakdown data was analyzed in terms of the existing models of aging using Weibull cumulative hazard functions and a procedure was developed for the inference of the life expectancy of cables from accelerated aging tests and dielectric strength measurements. A correlation was noted between electrical integrity of XLPE insulated cables and water treeing. The degree of aging under laboratory accelerated conditions is a nonlinear function of aging time. Under source aging conditions the degree of aging appears to be a linear function of time, thus, the final breakdown process of in-source aged cables may be different from that of laboratory aged cables. Further work is necessary to refine and validate an aging mode/and to develop an accelerated aging test that simulutes service aging. 27 refs., 27 figs., 8 tabs.

41932 (BNR–SD-180) **Position papers on influence vector feasibility (restricted).** Carr, J.; Hess, D.; Smith, K. Bell Northern Research Ltd., Ottawa, ON (Canada). 1986. 53p. (CE–02633). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The purpose of these investigations was to determine whether it is technically feasible to establish a new measure of the electromagnetic coordination between power and telecommunications systems. Existing measures are inadequate and a new "influence vector" has been postulated. It was concluded that the influence vector is a technically viable concept; however, it is complicated by the need for two separate but interactive components, the conductive influence vector (direct ohmic connections between systems) and the field influence vector (electromagnetic coupling between systems). The steps required to move from the current state of knowledge to the routine use of influence vectors in coordination engineering are listed and the corresponding R&D requirements are discussed. 11 refs, 8 figs., 4 tabs.

41933 (CEA/RD–259-T-702) **Evaluation of safe working clearances. Parts 1 and 2.** Hotte, P.W. Canadian Electrical Association, Montreal, PQ (Canada). 1989. 166p. (CE–02696). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The widely disparate safe working distances to live conductors ("limits of approach") stipulated by the Canadian utilities are reviewed and compared in Part 1. The safe working distance is viewed as having two components: an electrical and an ergonomic component. The method of derivation of the electrical component is reviewed, and the effect of recent findings described. Factors determining the ergonomic component are discussed. Part 2 deals with the electrical component of the safe working distance. The latest information on switching surge breakdown of air gaps is reviewed, and an appropriate gap breakdown formula suggested. An attempt is made to define the most adverse influences of various parameters that affect the breakdown voltage, such as gap factor, surge waveshape, and atmospheric conditions. The additional effects of certain work site conditions and surge limiting measures are also considered. The overall risk of flashover, associated with the proposed formula, is estimated and found to be very low. On account of this low risk, and because the suggested formula would result in larger limits of approach than the present method of IEEE Standard 516, the report identifies several questions that must be resolved before this new method can be adopted. 73 refs., 48 figs., 40 tabs.

41934 (ENEL–420.620-9) **Zinc-oxide surge arrester normatives: present and future.** Bargigia, A. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Mar 1987. 36p. (In Italian). Order Number DE89761921/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The paper describes the steps which have been taken, and those which must be planned for the future, in order to provide complete and adequate normative for the design and fabrication of zinc-oxide surge arresters, used as protection equipment for electric component overvoltages. Definitions of terminology, relative to the functional and construction characteristics, and specifications for a complete range of tests designed to guarantee a reasonable degree of safety, reliability and service life, are given.

41935 (ENEL–440.190-14) **Italian public electric distribution network: method to analyze impact of additional power generating stations.** Scalcino, S.; Tonon, R. Ente Nazionale per l'Energia Elettrica, Rome (Italy). May 1986. 33p. (In Italian). Order Number DE89761933/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

This paper deals with the problem of the impact of additional power generation systems on the Italian public electric distribution network. Economic and technical evaluations are made. The models adopted, to incorporate the structural characteristics and operating criteria of the high, medium and low voltage distribution levels, are described. The influence of diffused generation on the distribution network is examined in its various aspects - effects on voltage, the variation of voltage service quality, losses, reliability, operating problems, programmed reserves.

41936 (ENEL–440.270-13) **Direct probabilistic approach to evaluate reliability of complex electric equipment or of parts of the power transmission system.** Camensig, C.; Scalcino, S. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Apr 1987. 5p. Order Number DE89761889/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

In reliability studies of large power systems, it may be necessary to make separate study of parts of the systems of particular importance and complexity (e.g. substation, power stations, etc.). For this purpose, it may be useful to utilize fast and even approximate methods, such as the minimal cut-set method, that allows fast computation of reliability also in cases in which, due to the large number of components, the Markov method is inapplicable. The paper reviews the principles underlying the minimal cut-set method and describes a new and useful algorithm, based on the adjacency relationship between various components, for the determination of the minimal cut-sets. The paper also suggests an interesting formula, by which it is possible to estimate the maximum difference between the obtained value and the actual value of reliability and illustrates how to take into account the presence of spares; in order to clarify and underline the capabilities of the adopted method, an example of an application is given.

41937 (IREQ–004D458) **Mechanical rating scheme for polymer distribution post insulators.** Lanteigne, J.; Dugre, M.; de Tourreil, C. Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). 1989. 101p. (CE–02701). Available from Canaddan Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The objective of this study is to provide Canadian utilities with a means of rapidly evaluating polymer line post insulators and determining their minimum mechanical characteristics in order to establish their equivalence to conventional porcelain insulators. The report covers the following aspects: experimental data for evaluating the mechanical behavior of insulator core materials, finite-element computations of the stress distribution and determination of prevailing failure modes and preferred failure locations, mechanical tests, and improvements and rating scheme. 6 refs., 65 figs., 18 tabs.

41938 (IREQ–183-T-357) **Performance evaluation of optical fibre HV [high voltage] controls links.** Missout, G.; de Tourreil, C.; Couderc, D.; Dery, M.; Masse, M.; Thivierge, J.-P. Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). 1988. 80p. (CE–02630). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The objective of this project was to develop comparative test procedures to assess the electrical performance of fibre optic links of different designs. A preliminary study identified a variety of high-voltage fibre-optic systems. Test procedures were developed and applied to evaluate various fibre-optic links. A new thermal cycling apparatus, based on a transfer chain principle, was developed to test optical fibres embedded in composite insulators. The test methods are described together with the results, which show a good differentiation between the tested samples. In each main high-voltage fibre-optic design, at least one sample passed the pertinent test. Manufacturers and users surveys of high-voltage fibre-optics are given at the end of this report. A BASIC program for data acquisition in the HP110 controller is provided. 63 refs., 27 figs., 10 tabs.

41939 (IREQ–231D488) **Voltage unbalance on distribution systems. Phase 1.** Bergeron, R.; Beauregard, F.; Simard, J.; Kelley-Regnier, L. Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). 1989. 56p. (CE–02620). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The aim of the work described in this final report was to define the typical amount of voltage unbalance experienced on power distribution systems across the country. The first step was to determine the technical approach to unbalance evaluation and calculation. A literature search revealed that the unbalance factor had conventionally been defined on the basis of the ratio of the rms value of the negative sequence to the positive sequence of system voltages, but this approach was felt to be far too demanding with respect to effort and comlexity and too subject to risks of calculation errors. The National Electrical Manufacturers Association had therefore proposed a much simpler, albeit somewhat less precise, method that nevertheless comprises four sources of error, as identified and evaluated during this project. The second step was to contact 31 utilities in the framework of a survey designed to build up a database on voltage unbalance in Canada. The survey revealed that few utilities had established criteria on unbalance but that in three years alone 637 complaints had been received and had led to a total investment of $68,800 in applying appropriate solutions. Some 50 million voltage measurements were then recorded at six test sites across the country and processed in order to assess the typical voltage unbalance found on Canadian distribution networks. Typical values were determined for four supply voltage levels and a new measurement and analysis method was developed, which is proposed for standardization across Canada. 15 refs., 14 figs., 14 tabs.

41940 (MHVDC–288-T-586) **Modelling of transformer saturation in stability studies.** Burton, R.S. Manitoba HVDC Research Centre, Winnipeg, MB (Canada). 1989. 129p. (CE–02695). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Models for transformer saturation that are currently available for use in load flow and stability programs were reviewed. The consequences of not modelling saturation were examined and a mathematically sound model for load flow and stability studies was developed. Methods of obtaining saturation data by field testing of existing transformers were also developed. 11 refs., 65 figs., 5 tabs.

41941 (OH/ERD–88-166-K) **Conductors for overhead transmission. Benefits of using compact, low-loss, and larger diameter conductors.** Barrett, J.S.; Green, M.A. Ontario Hydro, Toronto, ON (Canada). Electrical Research Dept. 1988. 18p. (MICROLOG–89-02544). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The cost of building and operating overhead transmission lines is governed by the choice of conductor. Selecting a larger conductor will increase the capital cost of a line, but decrease the resistive energy losses and the need for generating facilities to provide the lost energy. Simple economic analyses are used in this report to demonstrate the potential for very substantial savings through the use of larger and more carefully designed conductors. Use of Compact Aluminum Conductor Steel-Reinforced (ACSR) conductors in place of Conventional "round-wire" ACSR, for all future upgrading and new construction projects, could yield savings in excess of $400 m. The benefits of low-loss conductors, designed with methods developed in the Research Division, could exceed $40 M, while the use

of larger diameter conductors in new construction and a long term replacement program, to shift the balance between losses and capital line costs, could save a further $500 M. 7 refs., 3 figs., 5 tabs.

41942 (OH/RD–88-66-K) **Use of polymeric transmission cables in Ontario Hydro. Task Force report.** Gupta, B.K. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 11p. (MICROLOG–89-02571). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A task force was set up to examine the future use of polymeric transmission cables in Ontario Hydro. Based on a comparison of polymeric and Low Pressure Oil-Filled (LPOF) transmission cables, and a review of the availability and service record of polymeric transmission cables around the world, this report recommends the use of metal sheathed polymeric transmission cable as an acceptable alternative to LPOF cable in forthcoming 230 kV installations. 46 refs., 3 tabs

41943 (OH/RD–88-67-K) **Evaluation of set 45 magnesium phosphate concrete for use in constructing tower pads.** Deans, J.J. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 73p. (MICROLOG–89-02572). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report summarizes the research undertaken to assess Set 45 magnesium phosphate concrete as a bearing pad material for transmission line construction at low temperatures 10 to 20C. Laboratory tests were carried out to determine the physical characteristics of this material when subjected to various environments. The results of this program identify major deficiences in the product and, the material is not recommended for use. 50 figs, 2 tabs.

41944 (OH/RD–88-86-K) **Ampacity studies of Riverside Jct x Strachan TS [thermal sand] cable circuits.** Anders, G.J. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 22p. (MICROLOG–89-02568). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The results of computations of cable ampacities based on field measurements of thermal resistivities and the application of the classical IEC/Neher-McGrath techniques are reported. This report also introduces a probabilistic method for the thermal analysis of power cables in the system planning process. An advanced finite element method in conjunction with the Monte Carlo simulation is applied for calculating the temperature rise of power cables with provision for statistical variations of various soil, boundary and loading conditions. The probability distribution of cable operating temperature is obtained and used in performing the cost-benefit analysis of delaying new cable installations. 12 refs., 14 figs., 5 tabs.

41945 (OH/RD–88-98-K) **Availability of data on pole testing and treating.** Bartlett, S.A.; Olivares, T.C. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 17p. (MICROLOG–89-02551). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An assessment was made to determine whether sufficient data were available to evaluate the effectiveness of Ontario Hydro's wood pole retreatment program. The ultimate goal of this evaluation is to recommend continuation, improvement, or discontinuation of the program. A questionnaire was sent to all area offices of Ontario Hydro to determine the adequacy of records kept about tested and treated poles. The results of the questionnaire indicate that the data available are not sufficient for the evaluation, and a survey in the field is necessary to gather the data required. 3 refs., 3 tabs.

41946 (OH/RD–88-135-K) **Evaluation of anchor grouting and bearing pad materials for use in transmission line construction at low temperatures. Field evaluation of anchor grouts. Drilling and anchor installation.** Deans, J.J.; Sato, J.A. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 11p. (MICROLOG–89-02559). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In 1987, a laboratory investigation was undertaken to assess anchor grouting materials, suitable for use at sub-freezing temperatures, for the construction of transmission lines. Part of this investigation included carrying out field trials (IE, rock anchor pullout tests) using the most promising grouts identified in the laboratory study. These pullout tests were conducted in May 1988, at a site near Lennox Transforming and Generating Station. The purpose of this report is to summarize the rock drilling procedure and subsequent installation (grouting) of the anchor rods.

41947 (OH/RD–88-149-K) **The chemistry of fog water.** Tam, Y.T. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 19p. (MICROLOG–89-02562). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Fog frequently occurs for extended periods of time during freezing rain storms. Fog water can be intercepted by insulators and lead to icing and wetting. Contaminants in the fog water would thus be deposited on the insulators. This report contains a summary of the data on the chemistry of fog water as measured at Trafalgar transmission station (TS) and as reported in the open literature. The few measurements made at Trafalgar TS indicate that the conductivity of fog water is highly variable. Similar conclusions were drawn from the literature data. While these results suggest that fog water may be an effective medium for contaminating insulator surfaces, such conclusions must await the collection of additional field data. It is recommended that the study of fog water be expanded. 15 refs., 6 figs., 3 tabs.

41948 (OH/RD–88-167-K) **Analysis of switching duty expected on high-speed 500 kV SF6 disconnects at Bowmanville SS [service station].** Narang, A. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 11p. (MICROLOG–89-02563). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Analytical studies and computer simulations were performed to predict the duty imposed on 500 kV SF6 disconnects when switching Darlington nuclear generating station service transformer potential. The results show that the disconnects may be required to interrupt transformer inrush currents approaching 20 A peak, which is considerably more severe than the specified levels of 4 A inductive or 1 A capacitive current. Since there is no evidence that the disconnects are capable of this more severe duty, it is recommended that the switch manufacturer be consulted before a decision is made to use the disconnects as planned. 10 refs., 8 figs., 1 tab.

41949 (OH/RD–199T425) **The long term stability of valve elements used in metal-oxide arresters. Addendum.** Kirkby, P. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 66p. (CE–02624). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This is an addendum report to the original report on the long term stability and life expectancy of metal-oxide valve elements used in alternating current gapless surge arresters. It provides results on valve elements from two additional manufacturers; 11 were covered in the original report. The power dissipation was monitored in long term stability tests that ran for over 4000 h in ovens at temperatures ranging from 75 to 175^{0}C. The results again show marked differences in the performance of the various products, demonstrating the evolving nature of metal-oxide valve materials. One of the products became more stable as it aged. The other product showed little

change for the lower temperatures, 130°C and lower, whereas the tests at 145°C and higher yielded an increasing power dissipation with time. These results, like the previous results, suggest that the Dakin-Arrhenius equation on lifetime has been over-emphasized in the literature. The energy discharge capacity of the two products has been determined from power-temperature data. The capacity is a function of applied voltage and ambient temperature. This emphasizes the need to know the conditions under which an arrester is to be operated. For completeness, this addendum contains much of the original report. An article on the same subject is given as an appendix. 27 refs., 21 figs., 9 tabs.

41950 (OH/RD–208-D-455) **Fibre optic communication field test on distribution systems. Phase 1.** Piercy, R.; Hatanaka, G. Ontario Hydro Research Div., Toronto, ON (Canada). 1986. 158p. (CE–02636). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The possible applications of fibre-optic communication technology on electric distribution systems are identified and analyzed for technical and economic feasibility. The commercially available fibre-optic communication equipment are surveyed and summarized, including costs when possible. Most distribution system applications are connected with distribution automation. Applications that require large amounts of fibre-optic cable to be purchased and installed are not cost effective compared to the alternative communication systems. Many electric utilities have experience with the installation, operation, and maintenance of fibre-optic systems and no major difficulties have been encountered. A field test of fibre-optic communication equipment on distribution systems is not required at this time. A survey of electric utilities and a list of manufacturers are given at the end of the report. 37 refs., 17 tabs.

41951 (OH/RD–8806) **Equivalent circuits for residence electrical services, including ground networks.** Donnelly, K.E. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 15p. (MICROLOG–89-02557). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

For the purpose of determining sources of residential magnetic fields, equivalent circuits for local primary and secondary distribution networks are analyzed. The analysis focuses on 120/240 v service drops to homes, emphasizing neutral and ground return paths, and illustrates possible inteactions between neighbouring homes. Phase differences may occur with induced currents or 3-phase primaries, and must be anticipated in a measuring program. An example is given of adjacent buildings which appear to be exchanging sizable ground currents flowing through a common water service. 9 figs.

41952 (PB–89-177299/XAB) **Anomalous failure of toughened-glass HVDC insulators.** Reynders, J.P.; Meal, D.U. Council for Scientific and Industrial Research, Pretoria (South Africa). National Electrical Engineering Research Inst. 1987. 7p. (CSIR-R-ELEK–403). Available from NTIS, PC EE04/MF E04.

North American Continent sales only.

Service experience on the Cahora Bassa high-voltage DC (HVDC) line has shown that the annual failure rate of HVDC-toughened-glass insulators is more than 10 times that experienced with similar HVAC insulators. This paper proposes that there is an accumulation or depletion (depending on the polarity) of sodium and potassium ions in the glass where areas of high local direct electric stress occur. With the passage of time, this depletion or accumulation leads to a redistribution of mechanical stress within the glass, resulting in failure. The proposal is illustrated in a series of controlled experiments in which direct fields with local concentrations comparable to those found in toughened glass insulators operating under service conditions are shown to lead to spontaneous shattering of the glass after a period of voltage application.

41953 (PB–89-177380/XAB) **Review of EHV air-breakdown studies in South Africa.** le Roux, B.C.; Britten, A.C.; Sadurski, K.J.; Chilton, A.C. Council for Scientific and Industrial Research, Pretoria (South Africa). National Electrical Engineering Research Inst. 1987. 17p. (CSIR-R-ELEK–417). Available from NTIS, PC EE04/MF E04.

Pub. in Proceedings of the CIGRe Open Conference on EHV Transmission Systems, Indaba Conference Centre, 1-14(October 19, 1987).

This paper reviews the current status of air-breakdown studies at two moderately high-altitude (1 425 m and 1 540 m) Extra-High Voltage (EHV) laboratories in South Africa. Special emphasis is given to the development of local EHV and Ultra-High Voltage (UHV) engineering expertise, as well as the work done towards the design refinement of a high-altitude 765-kV transmission line tower.

41954 (SPC–144T307) **Internal damping of ACSR [aluminum conductors steel-reinforced] conductors and alumoweld and galvanized steel ground wires, vol. 1.** Chan, R.K.; Wilson, M.W. Saskatchewan Power Corp., Regina, SK (Canada). 1988. 128p. (CE–02621). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This project was separated into two phases. In phase 1, 8 aluminum conductors steel-reinforced (ACSR), including 5 ACSR types, were used to evaluate the internal damping of such conductors with 1, 2, and 3 aluminum layers under various tensions, excitation frequencies, vibration amplitudes, and conductor ages. A mathematical model was developed to assist in interpreting the internal damping results. Experimental verification of the mathematical model proved the model's validity and usefulness in an experimental work of this nature. The analysis of the internal damping measurements showed that the two most important parameters affecting internal damping per unit length (P) were the normalized peak to peak free loop antinode displacement amplitude (Y) and the vibration frequency (w) according to equations of the form $P = A Y^2 w^{2-3}$, where A is a constant. The tension and conductor age had very little influence on the internal damping of a conductor. In phase 2, the internal damping of 6 cables was measured using the power method on a 36 m span. The frequencies to be studied were chosen to lie in the range of those predicted for each cable at commonly experienced wind speeds, as were the amplitudes. The power law relationship was used and the method of least squares was applied to correlate the experimental data. An equation of the form used in phase 1 was found adequate to describe the internal damping of these cables, with the value of the exponents depending on the cable type. The parameters of this equation are discussed. 19 refs., 25 figs., 23 tabs.

21 NUCLEAR POWER PLANTS

Refer also to citation(s) 41764, 42082, 42102, 42957, 43005

41955 (IAEA-TECDOC–491) **Nuclear data for the calculation of thermal reactor reactivity coefficients. Proceedings of an advisory group meeting held in Vienna, 7-10 December 1987.** International Atomic Energy Agency, Vienna (Austria). Jan 1989. 132p. (CONF-8712144–: Advisory group on nuclear data for the calculation of thermal reactor reactivity coefficients, 7-10 Dec 1987). Order Number DE89635489/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

On its 15th meeting in Vienna, 16-20 June 1986, the International Nuclear Data Committee (INDC) considered it important to review the accuracy with which changes in thermal reactor reactivity resulting from changes in temperature and coolant density can be predicted. It was noted that reactor physicists in several countries had to adjust the thermal neutron cross-section data base in order to reproduce measured reactivity coefficients. Consequently, it appeared to be essential to examine the consistency of the integral and differential cross-section data and to make all the information available which has a bearing on reactivity coefficient prediction. Following the recommendation of the INDC, the Nuclear Data Section of the International Atomic Energy Agency, therefore, convened the Advisory Group Meeting on Nuclear Data for the Calculation of

Thermal Reaction Reactivity Coefficients, in Vienna, Austria, 7-10 Dec. 1987. The Conclusions and Recommendations of the meeting together with the papers presented, are submitted in the present document. A separate abstract was prepared for each of these 12 papers. Refs, figs and tabs.

41956 (NUREG–0020-Vol.13-No.7) **Licensed operating reactors: Status summary report data as of June 30, 1989.** Nuclear Regulatory Commission, Washington, DC (USA). Office of Information Resources Management. Aug 1989. 512p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A22/MF A01 - GPO - OSTI.

The US Nuclear Regulatory Commission's monthly LICENSED OPERATING REACTORS Status Summary Report provides data on the operation of nuclear units as timely and accurately as possible. This information is collected by the Office of Information Resources Management, from the Headquarters Staff of NRC's Office of Inspection and Enforcement, from NRC's Regional Offices, and from utilities. This report is divided into three sections: the first contains monthly highlights and statistics for commercial operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices, IE Headquarters and the utilities; and the third section is an appendix for miscellaneous information such as spent fuel storage capability, reactor years of experience and non-power reactors in the United States.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

Refer also to citation(s) 41671, 41991, 42029, 42066, 42067, 42089, 42095, 42110, 42112, 42114, 42117, 42120, 42121, 42124, 42128, 42154, 42157, 42158, 42161, 42162, 42166, 42167, 42168, 42169, 42170, 42171, 42968, 42972

41957 (EPRI-NP–6147-Vol.1) **Evaluation of discrepancies in assembly cross-section generator codes: Volume 1: Final report.** Fisher, J.R.; Grow, R.L.; Hodges, D.; Rapp, J.S.; Smolinske, K.M. Electric Power Research Inst., Palo Alto, CA (USA); Utility Resource Associates, Rockville, MD (USA). c Jul 1989. 82p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The capabilities of utility reactor analysis technical staffs have increased significantly over the past five to ten years. Utilities utilize different cross section generators (EPRI-CELL, CPM, CASMO), different versions of these generators and different libraries in the generators, to produce input to different nodal codes. Phase I of this project utilized available data from utility calculations to identify the areas of differences in calculated results and to make an initial assessment of the potential impact and/or consequence of these differences. Phase II of this project investigated these differences via a consortium of utilities performing calculations for pin cells and multi-cells using controlled input data and options. The Phase II goal was to quantify differences and to determine if the differences were due to cross section library, cross section code methodology or the procedure for utilizing a code. This investigation has shown that significantly different results are obtained from the cross section generator codes/libraries for K_{∞} vs enrichment, cold (68°F) K_{∞}, K_{∞} vs exposure, Doppler worth, burnable poison worth vs exposure (both Gd and BPRs), and control rod worths. The codes/libraries give similar results for soluble boron worth, xenon worth, void worth, and temperature history effect. 4 refs., 13 figs., 16 tabs.

41958 (EPRI-NP–6147-Vol.2) **Evaluation of discrepancies in assembly cross-section generator codes, Volume 2: Final report.** Fisher, J.R.; Grow, R.L.; Hodges, D.; Rapp, J.S.; Smolinske, K.M. Electric Power Research Inst., Palo Alto, CA (USA); Utility Resource Associates, Rockville, MD (USA). c Jul 1989. 158p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The capabilities of utility reactor analysis technical staffs have increased significantly over the past five to ten years. Utilities utilize different cross section generators (EPRI-CELL, CPM, CASMO), different versions of these generators and different libraries in the generators, to produce input to different nodal codes. Phase I of this project utilized available data from utility calculations to identify the areas of differences in calculated results and to make an initial assessment of the potential impact and/or consequence of these differences. Phase II of this project investigated these differences via a consortium of utilities performing calculations for pin cells and multi-pin cells using controlled input data and options. The Phase II goal was to quantify differences and to determine if the differences were due to cross section library, cross section code methodology or the procedure for utilizing a code. This investigation has shown that significantly different results are obtained from the cross section generator codes/libraries for K_{∞} vs enrichment, cold (68°F) K_{∞}, K_{∞} vs exposure, Doppler worth, burnable poison worth vs exposure (both Gd and BPRs), and control rod worths. The codes/libraries give similar results for soluble boron worth, xenon worth, and temperature history effect.

41959 (IAE–4595/4) **Methodological aspects of measuring the coefficients of gaseous fission product distribution in two-phase (steam-water) systems.** Slavyagin, P.D.; Elizarov, V.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1988. 20p. (In Russian). Order Number DE89635499/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The modelling of measuring the gaseous fission product distribution coefficients in two-phase (steam-water) systems is carried out and comparison is made with the results obtained in special experiments in the VK-50 reactor. The theoretical formula, connecting the value of experimental distribution coefficient with the theoretical Henry coefficient vig the parameters of a reactor and fission product measuring method, is obtained and confirmed by the experimental data. 7 refs.; 5 figs.; 4 tabs.

41960 (JAERI-M–89-002) **Thermal-hydraulic characteristics of double flat core HCLWR.** Sugimoto, Jun; Iwamura, Takamichi; Okubo, Tsutomu; Murao, Yoshio. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1989. 22p. Order Number DE89906454/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A thermal-hydraulic characteristics of double flat core high conversion light water reactor (HCLWR) is described. The concept of flat core proposed by Ishiguro et al. is to achieve negative void reactivity coefficient in tight lattice core, and at the same time, high conversion ratio and high burnup can be obtainable. The proposed double flat core HCLWR, based on these physical advantages and the consideration of safety assurance, aims at efficient use of the pressure vessel space to produce comparable thermal output as current 3-loop PWRs. The present work revealed the following items concerning the thermalhydraulic feasibility of the double flat core HCLWR: (1) Main thermal-hydraulic parameters of the plant can be almost the same as current PWRs, showing the use of PWR standard components without major modifications except in core region. (2) Heat removal from the fuel rod in a steady operational condition has enough margin to the critical heat flux (CHF) limit, which is evaluated with the existing CHF correlations. (3) The calculation by REFLA code shows that the maximum cladding temperature in LOCA-reflood is estimated to be far lower than the licensing criteria. It is therefore considered that the proposed double flat core HCLWR is feasible from the point of thermal-hydraulics. Since the available data base has certain applicational limit to the very short core as the present double flat core HCLWR, further detailed assessment is required. (author).

41961 (JAERI-M–89-034) **BWR LOCA simulation test (RUN 992) in ROSA-III program for a 10% main steam line break with ECCS double failures.** Suzuki, Mitsuhiro; Anoda, Yoshinari; Kumamaru, Hiroshige; Nakamura, Hideo; Yonomoto, Taisuke; Koizumi, Yasuo; Murata, Hideo; Tasaka, Kanji. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1989. 164p. Order Number DE89906474/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

A loss-of-coolant accident (LOCA) caused by pipe rupture at the high pressure core spray (HPCS) line is equivalent to a LOCA with double failures on the emergency core cooling systems (ECCSs) in a boiling water reactor (BWR) system by assuming single failure on another ECCS. This report presents the ROSA-III experimental results of RUN 992, which simulates a 10% main steam line break

(MSLB) LOCA with double failure assumption on the HPCS and the low pressure core spray (LPCS) systems. The ROSA-III test facility simulates a BWR system with volumetric scale of 1/424 and has the principal systems, i.e., four half-length electrically-heated fuel bundles, two active recirculation loops, four types of ECCSs, and steam and feedwater systems. The report clarifies effectiveness of ECCS even for this double failure assumption in a 10% MSLB LOCA and also clarifies effects of the automatic depressurization system (ADS) on core cooling. In addition to these, mass balance and mass distribution in the system were investigated to clarify the core cooling condition in the small MSLB LOCA test. (author).

41962 (NUREG–1371) **Technical specifications, Limerick Generating Station, Unit No. 2 (Docket No. 50-353): Appendix "A" to license No. NPF 84.** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. Jul 1989. 530p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A22/MF A01 - GPO - OSTI.

The Limerick, Unit 2, Technical Specifications were prepared by the US Nuclear Regulatory Commission to set the limits, operating conditions, and other requirements applicable to a nuclear reactor facility as set forth in Section 50.36 of 10 CFR Part 50 for the protection of the health and safety of the public.

41963 Benchmarking and qualification of the NUFREQ-NPW code for best-estimate prediction of multichannel core stability margins. Taleyarkhan, R.; McFarlane, A.F.; Lahey, R.T. Jr.; Podowski, M.Z. *Transactions of the American Nuclear Society (USA),* 57: 347-349 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

The work described in this paper focuses on the development, verification, and benchmarking of the NUFREQ-NPW code at Westinghouse for best-estimate prediction of multichannel core stability margins in US boiling water reactors (BWRs). The NUFREQ-NPW code can allow for generalized three-dimensional core analyses of BWRs. The code was modified at Westinghouse to allow for a mixed-fuel-type multichannel core-wide stability analysis. One of the key distinguishing features of NUFREQ-NPW over other stability codes is that the analytical model allows for the system pressure perturbation as an external forcing function. This enables direct comparisons against pressure perturbation test data, instead of inferring equivalent information via curve fitting of other transfer functions. The results of comparisons with experimental data using the Westinghouse methodology, which is based on the NUFREQ-NPW code, demonstrate the best-estimate predictive capability for BWR core stability margins. The methodology is thus suitable for design and licensing applications.

41964 Identification of two-phase flow regimes by neutron noise analysis. King, C.H.; Ouyang, M.S.; Pei, B.S. *Transactions of the American Nuclear Society (USA),* 57: 378-379 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

The identification of two-phase flow patterns in a nuclear reactor core is important to the design and operation of a boiling water reactor (BWR). Basically, two-phase flow shows some fluctuating characteristics even at steady-state conditions. These fluctuating characteristics can be analyzed by statistical methods for obtaining flow signatures. There have been a number of experimental studies conducted that a concerned with the statistical properties of void fraction of neutron noise in experimental reactors or BWRs. In this study, the authors propose a new technique of identifying the patterns of air/water two-phase flow in the core of the zero power reactor of the Institute of Nuclear Energy Research. This technique is based on analyzing the statistical characteristics of the neutron noise signals from the in-pile test loop by time-series modeling. Although only limited two-phase flow conditions have been studied so far in this investigation. The results justify application of this technique to wider flow conditions and more complicated duct geometries.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

Refer also to citation(s) 41671, 41752, 41753, 41755, 41756, 41957, 41958, 41960, 41991, 42029, 42031, 42066, 42084, 42085, 42089, 42100, 42104, 42105, 42106, 42107, 42108, 42109, 42110, 42111, 42112, 42113, 42114, 42115, 42116, 42117, 42118, 42119, 42121, 42122, 42123, 42124, 42125, 42126, 42127, 42128, 42129, 42150, 42155, 42156, 42159, 42160, 42161, 42162, 42164, 42165, 42167, 42171, 42172, 42443, 42470

41965 (ENEA-RT-COMB–88-8) **Italian computerized critically guide: description and validation.** Carotenuto, M.; Landeyro, P.A. ENEA, Casaccia (Italy). Dipt. Ciclo del Combustibile. Dec 1988. 58p. Order Number DE89761999/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

ENEA (Italian Commission for Nuclear and Alternative Energy Sources) collected engineering know-how on back-end nuclear plant design by means of an expert system, the most suitable software tool for this task. During the analysis, the design process was divided into different branches. At each branch of the design process the expert system related a computerized design procedure. Each design procedure was composed of a set of design methods, together with conditions of application and reliability limits. Within the framework of this expert system, in order to reproduce the designer's normal reasoning process, the nuclear criticality safety analysis procedure was developed in the form of a computerized criticality guide composed of two parts: (1) a computerized text, including theory, a description of the accidents which have occurred in the past and a description of Italian design experience (mainly PWR type reactors); and (2) an interactive computer aided calculation module, incorporating the Monte Carlo calculation code, containing a graphical facility for critical parameter curves. This report presents the computerized criticality guide for normal fuel cycle problems and its validation test.

41966 (ENEA-RT-TERM–86-9) **Fluid mass flow-rate in two phase regime: instrumentation, techniques and analytical models.** Furrer, M. Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Dipt. Reattori Termici. Mar 1987. 89p. (In Italian). Order Number DE89761997/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Prepared with knowledge acquired by the Author during his LOFT Program participation, as an Italian representative at the EG & G Company (Idaho Falls, USA), this report examines measurements of fluid mass flow-rate in the two phase regime in nuclear or non-nuclear facilities. Essentially, the report contents deal with density profile determination and analytical models for the layered and annular regimes, gamma densitometry systems (with reference to the SEMISCALE plant) and calibration techniques, drag devices for two-phase mass flow measurements, turbine type flow meters and spool-piece applications.

41967 (ENEA-RT-TERM–88-6) **Heat transfer and fluid flow in industrial plants. Experimental researches performed at ENEA (Italy) laboratories.** Palazzi, G.; Savelli, D. Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Dipt. Reattori Termici. Oct 1988. 54p. Order Number DE89761988/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The Experimental Engineering Division at ENEA (Italian Commission for Nuclear and Alternative Energy Sources) Casaccia Center is undertaking various researches in the thermo-fluid dynamics field regarding the improvement of industrial plant performance. In particular: - Steam Generators (S.G.) in PWRs. The program concerns U-tube S.G. improvement and S.G. behavior in accident conditions. - Condensers. An experimental study has been performed to improve the design of the condenser front and head to minimize erosion phenomena. - Feedwater Heaters. The activity aim is to improve industrial design capability by assessing a new and original code. - Valves. In the component qualification field, a large facility for the certification of safety and overflow valves has been built. Additional experiments have been performed to increase phenomenological and fundamental aspect knowledge. Concerning severe accident phenomena in nuclear plants, an experimental facility, called SPARTA, has been built to test the decontamination factor.

41968 (INIS-mf–11503, pp. 81-85) **Improving the simulation of the rod ejection accident in PWR.** Saphier, D. (Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center). Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

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The improved modelling of the core performed in the present study, reveals that in addition to major differences in the hot channel state variables, there is also a significant difference in the system average transient parameters, such as power, pressure, flow and temperatures. The major impact is however, the possibility to observe the transient behavior of the subassembly from which the control rod was ejected, as well as the subassemblies surrounding the 'ejected' assembly.

41969 (Juel-Conf–69, pp. 302-331) **In-service inspection, prerequisite for high NPP availability and safety.** Schultheiss, G.F. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Anlagentechnik). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct 1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

There exist different regulations or standards on in-service inspection (ISI) e.g. the IAEA Safety Series No. 50-SG-02, German KTA Safety Standards or ASME XI. The paper concentrates on examples taken from PWR's in the German power plant design concept by KWU. The relations between ISI activities, design, regulations and standards and plant operation are shown. (DG).

41970 (KFK–4476, pp. 283-295) **Theoretical analysis of high-burnup fuels of U, MOX, and reprocessed uranium.** Wiese, H.W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

The present inventory calculations for uranium and MOX fuels and fuel from reprocessed uranium (WAU), with burn-ups of up to 60 GWd/tSM were carried out using the KORIGEN burn-up program as well as a set of neutron cross sections newly developed by A. Mateeva and B. Krieg on the basis of JEF-1 and tested experimentally by A. Mateeva. In this context, the KARBUS spectral burn-up program was used for the setting up of KORIGEN theorems on cross sections and for the control of the KORIGEN calculations. The results allowed the exemplary discussion of the behaviour of some characteristics of fuels such as the heat release, radioactivity, masses of the main actinoid elements within a burn-up range between 40 and 50 GWd/tSM in a decay time of 7 years and of the change of the heat release over the time for 50 GWd/tSM. (orig.).

41971 (SIEMENS-KWU-U9–414/89/004) **Use of thorium fuel in light water reactors, studies performed by KWU, phase 2 A. Final report.** Peehs, M.; Doerr, W.; Gaertner, M.; Schlosser, G.; Gross, H. Siemens AG Unternehmensbereich KWU, Erlangen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Feb 1989. 22p. (In German). Contract BMFT AtT 9344/5. Order Number DE89795701/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Thorium fuel assemblies can be loaded in PWRs as replicas of standard fuel assemblies as regards design and power. From the nuclear design standpoint, (Th, Pu)O_2 fuel is capable of very high burnups, with the plutonium burning out completely. Code systems for thermomechanical fuel rod design, validated by results of irradiation tests, are available. A proven fabrication technology has been developed on the basis of fuel technology for HTRs (ex-gel process) and LWRs (direct pelletizing). Thorium fuel assemblies are best used in a once-through cycle, i.e. without reprocessing. The characteristics of spent thorium fuel assemblies as regards transport and storage resemble those of UO_2. (orig.).

41972 BMB-LWR core moderator coefficient and its WDR reactivity worth. Abu-Zaied, G. *Transactions of the American Nuclear Society (USA),* 57: 281-283 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

Control of the excess reactivity for burnup in pressurized water reactors (PWRs) is accomplished using soluble poison and/or burnable poison. The boron concentration must be limited during operating conditions to ensure that the moderator temperature coefficient (MTC) is negative. Sufficient burnable poison is installed at beginning of cycle (BOC) to give the desired cycle lifetime without exceeding the boron concentration limit. If the cyclelength is increased, the burnable poison loading has to be increased, which (for heterogeneous burnable poison, such as most boron-based schemes) displaces fuel rods and increases intraassembly power peaking. Note that even at end-of-cycle (EOC) conditions some residual poison remains, resulting in a net decrease in cycle lifetime. Accordingly, the next step is to search for concept variations that are more practical from a thermal-hydraulic view-point even at some sacrifice in fuel savings. The approach selected for subsequent study involved fuel reconstruction combined with the use if water displacement rods (WDRs) in a design concept designated as the breeder/moderator controlled/burner light water reactor (BMB-LWR). The reference reactor to which the new design was compared is a standard Westinghouse PWR, operating on an extended burnup fuel cycle, since the BMB-LWR core was also designed to have a longer cycle than has been past practice.

41973 Cost/benefit analysis of eliminating poison control in LWRs. Abu-Zaied, G. *Transactions of the American Nuclear Society (USA),* 57: 283-285 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

Since the economics of power generation determines, to a large extent,a utility's choice of reactor systems, the cost of electricity from a spectral shift control (SSC) reactor is a crucial measure of the SSC reactor's competitiveness. Thus, a preliminary cost analysis is an important part of our overall assessment. The economic comparisons in this work focus on the cost differences between a standard pressurized water reactor (PWR) and the breeder/moderator controlled/burner light water reactor (BMB-LWR) design concept. The BMB-LWR is a typical large current design PWR with a minimum of changes. The BMB-LWR does not use any poison for reactivity control in the cycle length range of interest (1 to 2 yr) and uses soluble poison only for refueling purposes, to provide a sufficient additional negative reactivity margin to supplement the water displacement system. However, the water displacement system is very similar to the control rod system from a mechanical design point of view, differing mainly in the characteristics of the in-core control pins. Mixing both poison and displacer pins in the same core introduces added complexity, but not necessarily at a large cost impact; e.g., the advanced PWR has substantial water displacement control components, whereas the BMB-LWR primarily increases the displacer-to-poison ratio. The annual credits and penalties of replacing the standard PWR with the BMB-LWR concept are covered in the analysis.

41974 Sensitivity analysis of annual savings of poison-free control in LWRs. Abu-Zaied, G. *Transactions of the American Nuclear Society (USA),* 57: 285-287 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

To examine how sensitive the annual savings of eliminating poison control in pressurized water reactors (PWRs) is to each cost component, a sensitivity study was performed for the breeder/moderator controlled/burner light water reactor (BMB-LWR) design concept. The new design (BMB-LWR) is compared to a standard Westinghouse PWR (Ref.3), operating on an extended burnup fuel cycle, since the BMB-LWR core is also designed to have a longer

burnup cycle than previously used. From the BMB-LWR design concept, the major cost credits of the poison elimination in PWRs are the 25% reload fuel saving, the elimination of part of the CVCS, and both burnable and control poison rods. The additional costs required to realize spectral shift control have been estimated. Three major penalties were incurred in transforming a standard PWR into the BMB-LWR; the costs associated with fuel reconstitution every cycle, the incorporation of the water displacement rod system, and doubling the pumping power (due to the reduced effective core flow area).

41975 PWR benchmarking of ARROTTA at beginning of life. Mosteller, R.D.; Rothleder, B.M.; Anderson, M.J.; Eisenhart, L.D.; Eich, W.J.; Chao, J. *Transactions of the American Nuclear Society (USA)*, 57: 309-311 (1988). (CONF-881011--: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

The advanced nodal code ARROTTA can perform multidimensional core analysis for a wide variety of both slow and rapid light water reactor (LWR) transients, as well as criticality searches and eigenvalue calculations. It recently has played the central role in the analysis of a pressurized water reactor (PWR) natural circulation transient without scram occurring at beginning of life (BOL). The severity of that transient was shown to be quite sensitive to the behavior of the moderator temperature coefficient (MTC) of reactivity; therefore, it is of considerable importance that the MTC be calculated very accurately. The present study extends that benchmarking to several additional PWRs and includes comparisons with reference results for isothermal temperature coefficients (ITCs) of reactivity. These reference results are provided either by fine-mesh, quarter-core PDQ7-E calculations or by measurements at operating plants. The ARROTTA code has been shown to predict eigenvalues, nodal power distributions, critical soluble boron concentrations, and ITCs that are in extremely good agreement with measured data and reference results for a variety of core designs at BOL. Furthermore, the accuracy with which ARROTTA calculates these parameters represents a significant improvement relative to one-group and one-and-a-half group nodal codes, which currently are widely used throughout the nuclear industry.

41976 Reactivity effects of fission product decay in PWRs. Aragones, J.M.; Ahnert, C. *Transactions of the American Nuclear Society (USA)*, 57: 311-312 (1988). (CONF-881011--: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

The purpose of the work reported in this paper is to analyze the effects of fission product chains with radioactive decay on the reactivity in pressurized water reactor (PWR) cores, calculating their accumulation and absorption rates along fuel burnup at continuous operation and after shutdown periods extending from 1 day to a few months. The authors PWR version of the WIMS-D4 code is first used to obtain the individual number densities, absorption rates, and averaged cross sections for every nuclide of the fission product chains with significant decay rates, as a function of fuel burnup at continuous irradiation. Next, by an auxiliary ad hoc code, these data, have been processed together with the required one for fissile nuclides and boron, also taken from WIMS at each burnup step, to calculate the average or effective values relevant for the analysis and the decay and change in overall absorption after several shutdown times. (1) The reactivity effect of fission product decay changes significantly with the shutdown time. The maximum absorption increase by decay is reached in $\approx$ 10 days' shutdown. (2) The dependence with fuel type, enrichment, and burnup is slight, but the change with previous power density is nearly linear, which might be significant after coast-down in previous cycles. (3) For long shutdown periods, the overall reactivity effect of decay in the three fission product chains considered is much less than if only the samarium peak due to ^{149}Nd is considered.

41977 Isotopic depletion of soluble boron in a PWR. Aragones, J.M.; Ahnert, C.; Crespo, A.; Leon, J.R. *Transactions of the American Nuclear Society (USA)*, 57: 314-315 (1988). (CONF-881011--: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

The purpose of the work reported in this paper is to determine the isotopic depletion of the soluble boron in the primary of a pressurized water reactor (PWR) along cycle operation under the limiting condition of continuous boron dilution without fresh boron feeding, which maximizes the boron isotopic depletion effect. Presented here are the results for cycle 4 of the C.N. Almaraz-II PWR, which has been operated close to these continuous dilution conditions at rated power throughout most of the cycle. The limiting continuous boron dilution model with the ^{10}B depletion calculations based on the COBAYA code is in quite good agreement with the measured boron concentrations for this cycle, explaining very well the differences found with the expected design letdown curve, which increased up to +60 ppm at middle of cycle when this work was done.

41978 New flow regime map and heat transfer correlation for tube bundles. Blanchat, T.K. (Texas A & M Univ., College Station (USA)); Hassan, Y.A. *Transactions of the American Nuclear Society (USA)*, 57: 376-378 (1988). (CONF-881011--: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

The steady generator is a major component is pressurized water reactors. Predicting the response of a steam generator is essential in studying the thermal-hydraulic behavior of a nuclear reactor coolant system. Therefore, many analytical and experimental efforts have been performed to investigate the thermal-hydraulic behavior of steam generators during operational and accident transients. The objective of this study is to accurately predict the behavior of the tube bundle side of steam generators. The RELAPL5/MOD2 computer code consistently underpredicts the degree of superheat. The flow regime transition criteria and heat transfer correlations are modified in an attempt to correctly predict the degree of superheat. This study indicates the need to implement heat transfer correlations and flow regime maps relevant to tube bundle flow situations. RELAP5/MOD2 has been modified to recognize a tube bundle geometry and to chose a flow regime map and heat transfer correlation appropriate for that geometry. A new flow regime map for flow in bundles was developed and implemented in the code.

41979 Improved theoretical CHF model for low-quality tube flow. Lin, Wenshan; Lee, Chienhsiung; Pei, Baushei. *Transactions of the American Nuclear Society (USA)*, 57: 383-384 (1988). (CONF-881011--: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

A theoretical critical heat flux (CHF) model based on the mechanism of microlayer dryout and Helmholtz instability for tube flow under pressurized water reactor operating conditions was presented previously by Less and Mudawwar. The purposes of this revision are to reconstruct the model on more solid theoretical bases and to improve the accuracy of CHF predictions.

2103 Power Reactors, Non-breeding, Graphite Moderated

Refer also to citation(s) 42062, 42103, 42128, 42130, 43442

41980 (AECL--9334S) **Chernobyl - a Canadian technical perspective. Executive summary.** Snell, V.G.; Howieson, J.Q. Atomic Energy of Canada Ltd., Sheridan Park, ON (Canada). CANDU Operations. Jan 1987. 12p. Order Number DE89635523/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

On April 26, 1986, the Number 4 reactor at the Chernobyl Nuclear Power Station in the Soviet Union suffered a severe accident which destroyed the reactor core and led to a loss of life. The four reactors at this station are of the RBMK-1000 type - boiling-light-water cooled, graphite moderated, vertical pressure-tube reactors, each generating 1000 MW of electricity through two turbines. AECL has carefully studied the accident, and the design of Chernobyl, to see if anything has been overlooked in the CANDU design. This report reviews the results of that study, in particular the relevant features of the Chernobyl design which exacerbated the accident, and compares them to the CANDU 600 design. A number of issues (the sign of the void coefficent and the pressure-tube design) have also been given some international prominence in the post-Chernobyl analysis; these are discussed in this report and shown to

be irrelevant to the CANDU design. Finally this report describes the subjects identified for further design follow-up in Canada.

41981 (IAE–4566/4) **Method for HTGR spherical fuel element nondestructive testing based on dynamic measurements of their efficiency in a critical assembly.** Lebedev, G.V.; Smirnov, O.N.; Zhukov, V.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1988. 16p. (In Russian). Order Number DE89635479/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The results of determining the content of fissionable material, absorbers and graphite in HTGR spherical fuel elements by the method based on measurements of reactivity changes, arising when spherical fuel elements, absorbing elements and elements without fuel pass through a critical assembly are given. The experiments were performed in the Astra critical uranium-graphite assembly. The investigation results and analysis of foreign experience indicate the possibility of testing the spherical fuel elements in a critical assembly equipped with a microcomputer-based automated measuring system, with required accuracy and fast response. 9 refs.; 6 figs.; 3 tabs.

41982 (INIS-mf–11503, pp. 56-58) **Simulation of loss of flow events in HTR-module.** Gal, D. (Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center); Tzoref, J.; Saphier, D. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Summary only.

41983 (INIS-mf–11503, pp. 69-70) **Modeling of the HTR module with DSNP.** Gal, D. (Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center); Saphier, D.; Tzoref, J. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Summary only.

41984 (INIS-mf–11503, pp. 76-79) **Gaseous release acting as driving force to sweep fission products from the primary circuit following core heat-up accident in medium sized HTGRs.** Moormann, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)); Iniotakis, N.; Barthels, H.; Ron, S. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Gaseous release from the various ceramic graphites following depressurization and core heat-up accident in medium sized HTGRs can significantly contribute to the driving force of sweeping fission products from the primary circuit. The retention characteristic of the ceramic graphites might also be affected. This preliminary analysis shows the possible significance of the gaseous release in sweeping the fission products from the primary circuit.

41985 (JAERI-M–89-013) **Core dynamics analysis code for high temperature gas reactor, 'BLOOST-J2'.** Nakagawa, Shigeaki; Hirano, Mitsumasa; Mitake, Susumu; Ohashi, Kazutaka. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1989. 48p. (In Japanese). Order Number DE89906470/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

This report presents the specification of core dynamics analysis code, 'BLOOST-J2', for the High Temperature engineering Test Reactor (HTTR). In this code, the one point approximate kinetics equation is solved for the core kinetics calculation, and the two dimensional time dependent heat conduction equation is solved for the heat transfer calculation. (author).

41986 (JAERI-M–89-035) **High-temperature chlorination reactions and detection of defective particles for thorium oxide based coated particle fuels.** Shiratori, Tetsuo; Akabori, Mitsuo. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1989. 27p. (In Japanese). Order Number DE89906502/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The practical application of the high-temperature chlorine leach techniques to detect coating failures and defects of thorium oxide based coated particle fuels for HTGRs examined. Simplification and safety in chlorination apparatus and procedures were improved by supplying chlorine gas by means of the thermal decomposition of carbon tetrachloride. As a result of the chlorination experiments, the effective chlorination condition for loose ThO_2 and (Th, U)O_2 coated particle fuels was found to be 2 hours and over at 1200degC, and the detection of the defective coated particle fuels was experimentally confirmed with microradiography and chemical analysis of the collected reactants as heavy metal chloride. The distinctive features of the defective particles chlorined at high-temperature were also examined with optical microscopy and EPMA. (author).

41987 (Juel–2261) **HTR-2000: Computer program to accompany calculations during reactor operation of HTGR's.** Thomas, F. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (Germany, F.R.). Jan 1989. 117p. (In German). Order Number DE89795717/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

HTR-2000 - developed for arithmetical control of pebble bed high temperature reactors with multiple process - is closely coupled to the actual operation of the reactor. Using measured nuclear and thermo-hydraulical parameters as well as detailed model of pebble flow and exact information and fuel burnup, loading and discharge it obtains an excellent simulation of the status of the reactor. The geometry is modelled in three dimensions, so asymmetries in core texture can be taken into account for nuclear and thermohydraulical calculations. A continuous simulation was performed during five years of AVR operation. The comparison between calculated and measured data was very satisfying. In addition, experiments which had been performed at AVR for re-calculating the control rod worth were simulated. The arithmetical analysis shows that at presence of a compensating-absorber in the reactor core the split reactivity worth for single absorbers can be determined by calculation but not by methods of measuring. (orig.).

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

Refer also to citation(s) 41980, 42046, 42064, 42065, 42068, 42069, 42070, 42439, 42996

41988 (AECL–8399) **Failure maps for internally pressurized Zr-2.5% Nb pressure tubes with circumferential temperature variations.** Shewfelt, R.S.W. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. Jan 1986. 20p. Order Number DE89635528/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

During some postulated loss-of-coolant accidents, the pressure tube temperature may rise before the internal pressure drops, causing the pressure tube to balloon. The temperature around the pressure tube circumference would likely be nonuniform, producing localized deformation that could possibly cause failure. The computer program, GRAD, was used to determine the circumferential temperature distribution required to cause an internally pressurized Zr-2.5% Nb pressure tube to fail before coming into full contact with its calandria tube. These results were used to construct failure maps. 7 refs.

41989 (AECL–8400) **LOCA simulation tests in the RD-12 loop with multiple heat channels.** Ardron, K.H.; McGee, G.R.; Hawley, E.H. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. Nov 1985. 26p. Order Number DE89635529/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A series of tests has been performed in the RD-12 loop to study the bahaviour of a CANDU-type, primary heat transport system (PHTS) during the blowdown and injection phases of a loss-of-coolant accident (LOCA). Specifically, the tests were used to

investigate flow stagnation and refilling of the core following a LOCA. RD-12 is a pressurized water loop with the basic geometry of a CANDU reactor PHTS, but at approximately 1/125 volume scale. The loop consists of U-tube steam generators, pumps, headers, feeders, and heated channels arranged in the symmetrical figure-of-eight configuration of the CANDU PHTS. In the LOCA simulation tests, the loop contained four horizontal heated channels, each containing a seven-element assembly of indirectly heated, fuel-rod simulators. The channels were nominally identical, and were arranged in parallel pairs between the headers in each half-circuit. Tests were carried out using various restricting orifices to represent pipe breaks of different sizes. The break sizes were specifically chosen such that stagnation conditions in the heated channels would be likely to occur. In some tests, the primary pumps were programmed to run down over a 100-s period to simulate a LOCA with simultaneous loss of pump power. Test results showed that, for certain break sizes, periods of low flow occurred in the channels in one half of the loop, leading to flow stratification and sheath temperature excursions. This report reviews the results of two of the tests, and discusses possible mechanisms that may have led to the low channel flow conditions observed in some cases. Plans for future experiments in the larger scale RD-14 facility are outlined. 5 refs.

41990 (AECL–8961) **RAHAB calculation of lattice parameters for CANDU-type lattices using Monte Carlo calculations for resolved resonance capture.** Craig, D.S.; Festarini, G.L. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Jul 1986. 39p. Order Number DE89635531/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The Monte Carlo code, REPC, has been used to calculate resonance reaction rates for the thermal test lattices TRX-1 and MIT-4, and for the CRNL lattices ZEEP-1, 19 UO_2 and 37 UO_2. These reaction rates were used in the RAHAB cell code to calculate k_{eff}, conversion ratios, and fast fission ratios, for comparison with experimental values. The calculations used the cluster geometry for the 19-, 28-, and 37-element clusters. Calculations were also made using annular representations of the cluster for comparison of the rates with those obtained using the discrete ordinate code OZMA.

41991 (AECL–9107) **Steam generator tube performance: experience with water-cooled nuclear power reactors during 1983 and 1984.** Tatone, O.S.; Meindl, P.; Taylor, G.F. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Jun 1986. 96p. Order Number DE89635533/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

A review of the performance of steam generator tubes in water-cooled nuclear power reactors showed that tubes were plugged at 47 (35.6%) of the reactors in 1983 and at 63 (42.6%) of the reactors during 1984. In 1983 and 1984 3291 and 3335 tubes, respectively, were removed from service, about the same as in 1982. The leading causes assigned to tube failure were stress corrosion cracking from the primary side and stress corrosion cracking or intergranular attack from the secondary side. In addition 5668 tubes were repaired for further service by installation of internal sleeves. Most of these were believed to have deteriorated by one of the above mechanisms or by pitting. There is a continuing trend towards high-integrity condenser tube materials at sites cooled by brackish or sea water. 31 refs.

41992 (AECL–9194) **Improved locations of reactivity devices in future CANDU reactors fuelled with natural uranium or enriched fuels.** Boczar, P.G.; Van Dyk, M.T. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Feb 1987. 16p. (CONF-860906–: American Nuclear Society topical meeting on advances in reactor physics and safety, 17-19 Sep 1986). Order Number DE89635535/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A new configuration of reactivity devices is proposed for future CANDU reactors which improves the core characteristics with enriched fuels, while still allowing the use of natural uranium fuel. Physics calculations for this new configuration are presented for four fuel types: natural uranium, mixed plutonium - uranium oxide (MOX) having a burnup of 21 MWd/kg, and slightly enriched uranium (SEU) having burnups of either 21 or 31 MWd/kg.

41993 (AECL–9260) **Reactor coolant pump seals: improving their performance.** Pothier, N.E.; Metcalfe, R. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Jun 1986. 24p. (CONF-8606427–: Symposium on advanced nuclear services, 11 Jun 1986). Order Number DE89635536/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Large CANDU plants are benefitting from transient-resistant four-year reliable reactor coolant pump seal lifetimes, a direct result of AECL's 20-year comprehensive seal improvement program involving R and D staff, manufacturers, and plant designers and operators. An overview of this program is presented, which covers seal modification design, testing, post-service examination, specialized maintenance and quality control. The relevancy of this technology to Light Water Reactor Coolant Pump Seals is also discussed.

41994 (AECL–9421) **Material and fabrication considerations for the CANDU-PHWR heat transport system.** Filipovic, A.; Price, E.G.; Barber, D.; Nickerson, J. Atomic Energy of Canada Ltd., Sheridan Park, ON (Canada). CANDU Operations. Mar 1987. 32p. (CONF-8703323–: International conference of nuclear equipment - welding and Q.A., Mar 1987). Order Number DE89635540/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

CANDU PHWR nuclear systems have used carbon steel material for over 25 years. The accumulated operating experience of over 200 reactor years has proven this unique AECL approach to be both technically and economically attractive. This paper discusses design, material and fabrication considerations for out-reactor heat transport system major components. The contribution of this unique choice of materials and equipment to the outstanding CANDU performance is briefly covered.

41995 (AECL–9514) **Behaviour of the CANDU calandria tubes.** Ells, C.E.; Coleman, C.E.; Fidleris, V.; Ho, E.T.C.; Causey, A.R. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Jul 1987. 12p. Order Number DE89635542/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The CANDU calandria tubes, made of annealed Zircaloy-2, have given excellent service in-reactor. The properties of Zircaloy-2, including its response to neutron irradiation, are very satisfacotry for this application. Examination of calandria tubes removed from reactors has shown that the material should continue to respond well to the reactor environment. Thus, continued good service from the tubes is predicted.

41996 (INFO–0251) **Aging of elastomers in CANDU pressure boundary service.** VanBerlo, C.; Leidner, J. Atomic Energy Control Board, Ottawa, ON (Canada). Sep 1987. 162p. Order Number DE89635544/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

This report describes the properties and aging of elastomers, and examines the performance of major elastomeric components in CANDU pressure boundary service. The components examined are vacuum building roof seals, pressure relief duct seals, airlock door seals, fuelling machine hoses, and cable penetrations. For each of these components, the design requirements, technical specifications and component testing procedures are compared with applicable standards. Information on actual and recommended monitoring and maintenance methods is presented. Operational and environmental stressors are identified. Component failure modes, causes and frequencies are described, as well as the remedial action taken. Many different elastomers are used in CANDU plants, for many different applications. Standards and manufacturers' recommendations are not consistent and may vary from one component to another. Accordingly, the monitoring, maintenance and replacement practices tend to vary from one application to another, and may also be different at different stations. Recommendations are given in this report for improved monitoring and maintenance, in an attempt to provide more consistency in approach. A summary of some experiences with elastomers from non-Canadian sources is contained in the last section. 125 refs.

41997 (INFO–0268) **Aerosols and fission product transport.** Megaw, W.J. Atomic Energy Control Board, Ottawa, ON (Canada). Dec 1987. 106p. Order Number DE89635546/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

A survey is presented of current knowledge of the possible role of aerosols in the consequences of in- and out-of-core LOCAs and of end fitting failures in CANDU reactors. An extensive literature search has been made of research on the behaviour of aerosols in possible accidents in water moderated and cooled reactors and the results of various studies compared. It is recommended that further work should be undertaken on the formation of aerosols during these possible accidents and to study their subsequent behaviour. It is also recommended that the fission products behaviour computer code FISSCON II should be re-examined to determine whether it reflects the advances incorporated in other codes developed for light water reactors which have been extensively compared. 47 refs.

41998 (INFO–0271) **AECB staff review of Bruce NGS 'B' operation for the year 1987.** Atomic Energy Control Board, Ottawa, ON (Canada). Jun 1988. 23p. Order Number DE89635547/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The operation of the Bruce 'B' Nuclear Generating Station is monitored and licensing requirements are enforced by the AECB Bruce project staff, with appropriate support from other AECB personnel. The staff observes operation of the reactors, conducts audits, witnesses important activities, reviews station documentation and reports, and issues approvals where appropriate in accordance with licence conditions. As required by a condition of its Operating Licence, Ontario Hydro, each year, submits Technical Reports which summarize various aspects of the operation of Bruce NGS 'B' during the year. When these reports have been reviewed by AECB staff, a formal Annual Review Meeting is held with the station management to discuss safety-related aspects of the station operation, and to inform Ontario Hydro of AECB staff conclusions with respect to the performance of Ontario Hydro in operating the station during the year. The purpose of this report is to summarize and record the conclusions of the AECB staff assessment of the operation of Bruce NGS 'B' during 1987. Bruce NGS 'B' was operated safely by Ontario Hydro during 1987. Given the station and staff performance, there are no reasons to believe that the station will not be operated safely in 1988. AECB staff does see a need for increased diligence by Ontario Hydro in completing preventative and required maintenance in a more timely manner. Also, Ontario Hydro must take action to ensure that the requirement for minimum staff complement is met on every shift.

41999 (INIS-mf–11506) **Review of Darlington.** Ontario Hydro, Toronto, ON (Canada). Sep 1985. 47p. Order Number DE89635548/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Report 649SP.

This multi-part report outlines the considerations and results of technical, economic and financial analyses, and analyses of the impact on Ontario's economy associated with continuation of Ontario Hydro's Darlington nuclear generation project. In addition, it assesses and compares the effects of partial or complete cancellation of the project. The introduction to follow briefly outlines the main contents of each part of the report.

42000 (NGD–9(1983)) **Ontario Hydro CANDU operating experience.** Jackson, H.A.; Woodhead, L.W.; Fanjoy, G.R. Ontario Hydro, Toronto, ON (Canada). Mar 1984. 94p. Order Number DE89635549/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The CANDU Pressurized Heavy Water (CANDU-PHW) type of nuclear-electric generating station has been developed jointly by Atomic Energy of Canada Limited and Ontario Hydro. This report highlights Ontario Hydro's operating experience using the CANDU-PHW system, with a focus on the operating performance and costs, reliability of system components and nuclear safety considerations for the workers and the public.

42001 (OH–85-239-K) **Feasibility of a tracer gas technique for containment leakage characterization at Bruce NGS.** Singh, V.P. Ontario Hydro, Toronto, ON (Canada). Research Center. Nov 1985. 27p. Order Number DE89635550/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Methods for tracer gas test have been conceived and are proposed for use in conjunction with other techniques used during off-power pressurization tests. During pressurization tests is appears possible to quantify leaks through containment boundaries which make up one of the walls in adjacent rooms but quantification of leaks to open areas will require further development. Several gases may be used as tracers during pressurization tests but the preferred tracer gas is sulphur hexafluoride (SF_6) at an in-vault concentration of 100 μL/L if open area sampling is to be carried out of 10 μL/L if only closed room sampling is to be performed. Large values of the ratio (tracer gas concentration in containment/lower detection limit) are necessary for identification of leak sites in open areas having significant ventilation flow. It is recommended that in-station trials be carried out to test the validity of this technique. In addition, a tracer gas technique for use during on-power operation is also proposed but leak site identification and quantification during on-power tests is only possible for containment boundaries which make up the wall(s) of adjacent rooms. The use of SF_6 is required for tests conducted during on-power operation. The recommended in-vault concentration is 10 μL/L. Recommendations are made for future work, including leak tests during on-power operation.

42002 (OH–85-248-K) **Airborne carbon-14 activities in the west vault of the unit 1 reactor at Pickering NGS.** Curtis, K.E. Ontario Hydro, Toronto, ON (Canada). Research Center. Oct 1985. 21p. Order Number DE89635551/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A large sampling and analysis program has been carried out to measure the airborne carbon-14 activities in the west vault during shock heating of four fuel channels in Pickering NGS Unit 1. Particulate carbon-14 activities varied from 0.02 to 2.9 μCi/m^3, depending on the sampling location and the fuel channel undergoing shock heating. By contrast, the gaseous carbon-14 activities were relatively constant for all samples, ranging from 1.6 to 5.2 μCi/m^3. Greater than 98% of this activity was found to inorganic, probably from $^{14}CO_2$. Tritium was also found in the gaseous samples at an average concentration about seven times higher than the carbon-14 activity.

42003 (OH–85-293-K) **OHRD metallurgical investigation of pressure tubes removed from Pickering 'B' unit 8.** Leger, M.; Shek, G.K.; Donner, A.; Vesely, P.G. Ontario Hydro, Toronto, ON (Canada). Research Center. Oct 1985. 33p. Order Number DE89635552/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A number of tubes were removed from Pickering Unit 8 due to excessive depth of fretting damage at dummy fuel bearing pad positions. Fifteen of these tubes were designated for destructive examination at three sites: AECL-CO, OHRD and CRNL. Examination of parts of six tubes from channels E08, F15, G10, J12, K18 and L14 were carried out at OHRD. The objective of the examination was to determine the extent of microcracking in the fret zones and to confirm the previously observed hydride distributions near fret marks. Results of the investigation show that there is no significant microcracking at the fret marks. However, secondary marks probably due to fretting by particles in the PHT coolant being trapped near bearing pads or under bundles, have been identified. These marks were studied in detail to determine their shapes for subsequent stress analysis. This report summarizes all these examinations.

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Refer also to citation(s) 41671, 42034, 42047, 42048, 42128, 42147, 42151, 43006

42004 (DOE/NE/37946–4) **Unconventional liquid metal cooled fast reactors: Final report, September 1, 1985–May 31, 1989.** Spinrad, B.I.; Rohach, A.F.; Razzaque, M.M. Iowa State Univ. of Science and Technology, Ames, IA (USA). Dept. of Nuclear Engineering. Jun 1989. 157p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC02-85NE37946. Order Number DE89016447/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This report describes the rationale for, design of and analytical studies on an unconventional sodium-cooled power reactor, called the Trench Reactor. It derives its name from the long, narrow sodium pool in which the reactor is placed. Unconventional features include: pool shape; reactor shape (also long and narrow); reflector

control; low power density; hot-leg primary pumping; absence of a cold sodium pool; large core boxes rather than a large number of subassemblies; large diameter metal fuel; vessel suspension from cables; and vessel cooling by natural circulation of building atmosphere (nitrogen) at all times. These features all seem feasible. They result in a system that is capable of at least a ten year reload interval and shows good safety through direct physical response to loss-of-heat-sink, loss-of-flow and limited-reactivity nuclear transients. 43 figs., 43 tabs.

42005 (ENEA-RT-PAS–86-22) **Inhalation of aerosols produced by sodium fires: effects on respiratory tract.** Giovanetti, A.; Pagano, P. Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Mar 1987. 61p. (In Italian). Order Number DE89761994/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

This paper takes stock of the state of knowledge on the effects of inhalation of aerosols produced by a sodium fire on health. The results of the experiments regarding inhalation of sodium combustion products, yielded on laboratory scale, by Sprague-Dawley rats are then reported. This study turns the attention to the toxic effects on the epithelium of the larynx and trachea. This research is carried out in the ambit of the activities that the Laboratory of Physics and Toxicology of Aerosols of the ENEA (Italian Commission for Nuclear and Alternative Energies) Department for the Protection of the Environment and Human Health (Physics and Biology Division) is developing on the atmospheric behavior of aerosols produced in a hypothetical accident in a fast reactor involving the cooling liquid, and also on its environmental and health effects, with particular regard to the experimental fast reactor, PEC, now in construction at Brasimone.

42006 (ENEA-RT-TIB–88-16) **Thermo-mechanical benchmark calculation with ABAQUS code of a failed hexagonal can in a LMFBR.** Zucchini, A. Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Dipt. Tecnologie Intersettoriali di Base. Oct 1988. 28p. Order Number DE89761991/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The safety analysis for LMFBRs requires the knowledge of the mechanical behavior of the hexagonal can of a fuel subassembly undergoing instantaneous total plugging. The problem is quite complicated because besides plastic deformation due to thermal and pressure loads, we have to face the partial melting of the can itself. Within the context of these studies, a mechanical benchmark problem was created (starting from realistic SPX1 data) with two main goals: - to qualify different available codes by reciprocal comparison; - to get some preliminary indications about the mechanical behavior of the structure. The present work is an analysis of this benchmark, performed by means of the ABAQUS structural code and a comparison of these results of the INCA code. The geometric nonlinearity was also taken into account and its effects underlined.

42007 (ENEA-RT-VEL–85-3) **Sodium cooled reactors: sodium chemical characteristics and purification (technology assessment). Volume 2.** Ferretti, F.; Fogliani, F. ENEA, Bologna (Italy). Dipt. Reattori Veloci. Feb 1985. 28p. (In Italian). Order Number DE89761984/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

This second report on sodium technology contains basic information about plant operating characteristics when sodium is utilized as a process fluid in experimental plants. Emphasis is given to knowledge relevant to the physical and chemical properties of sodium and purification techniques.

42008 (ENEA-RT-VEL–85-4) **Sodium cooled reactors: experimental plants (technology assessment). Volume 3.** Ferretti, F.; Fogliani, F. ENEA, Bologna (Italy). Dipt. Reattori Veloci. Feb 1985. 93p. (In Italian). Order Number DE89761983/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

These remarks on sodium technology contain basic information about plant operating characteristics when this coolant is utilized as process fluid in experimental plants. Furthermore, knowledge relevant to the chemistry of sodium and to plant safety, maintenance and instrumentation is furnished with the view of optimizing system management techniques. This third report of a series on technology assessment is dedicated to a description of the experimental plant components and their functions.

42009 (ENEA-RT-VEL–85-5) **Sodium cooled reactors: safety criteria for sodium cooling systems (technology assessment). Volume 4.** Ferretti, F.; Fogliani, F. ENEA, Bologna (Italy). Dipt. Reattori Veloci. Feb 1985. 26p. (In Italian). Order Number DE89761982/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

These remarks on sodium technology contain basic information about plant operating characteristics when sodium is utilized as process fluid in experimental plants. Furthermore, knowledge relevant to the safety, maintenance and instrumentation of sodium cooling systems is furnished. This fourth report of a series on technology assessment emphasizes safety criteria.

42010 (ENEA-RT-VEL–85-6) **Sodium cooled reactors: sodium cooling system operation and maintenance (technology assessment). Volume 5.** Ferretti, F.; Fogliani, F. ENEA, Bologna (Italy). Dipt. Reattori Veloci. Feb 1985. 15p. (In Italian). Order Number DE89761981/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

These remarks on sodium technology contain basic information about its operating characteristics when utilized as a process fluid in experimental plants. In this fifth of a series of technology assessment reports, the focus is on operating requirement and maintenance of sodium cooling systems.

42011 (ENEA-RT-VEL–85-7) **Sodium cooled reactors: instrumentation (technology assessment). Volume 6.** Ferretti, F.; Fogliani, F. ENEA, Boiogna (Italy). Dipt. Reattori Veloci. Feb 1985. 26p. (In Italian). Order Number DE89761980/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

In this series of reports on sodium cooled reactor technology, basic information is given relevant to plant operating characteristics when sodium is utilized as the process fluid in experimental plants. Emphasis in this sixth volume is upon sodium reservoir instrumentation - thermocouples, electromagnetic pumps, measuring instruments for the measurement of flow, sodium and argon pressure, and continuous and discontinuous probes for level indication.

42012 (ENEA-RT-VEL–88-02) **Cavitation, subcooled boiling and measuring methods developed at ENEA (Italy).** Tirelli, D. ENEA, Bologna (Italy). Dipt. Reattori Veloci. Jul 1988. 22p. (In Italian). Order Number DE89761966/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

In the design and experimental testing of hydraulic components of the PEC (FBR type) reactor primary circuit, particular attention was given to the study of cavitation. This report gives a brief description of cavitation and subcooled boiling phenomena - effects, measuring methods, operating limits and prescribed standards. The aim is to better clarify the performance and importance of a measuring instruments, developed at ENEA (Italian Commission for Nuclear and Alternative Energy Sources). The instrument was designed to measure, by means of a suitably positioned vibration sensor (accelerometer), the amplitude of structural vibrations produced by shock implosions of gas or vapor filled cavities on the interior walls of the hydraulic components.

42013 (ENEA-RT-VEL–88-04) **Fast breeder reactor reference system classification for the ENEA (Italian Commission for Nuclear and Alternative Energy Sources) data bank.** Righini, R. ENEA, Bologna (Italy). Dipt. Reattori Veloci. Nov 1988. 317p. Order Number DE89761971/JAW. Available from NTIS (US Sales Only), PC A14/MF A01.

This report contains the Reference System Classification (RSC) of fast breeder reactors: it provides a functional system breakdown of the reactor. For each system, the following important characteristics are reported: the main functions, the mode of operation, its location in the reactor, the main interface systems, its main components and the component working environment (fluid and/or atmosphere type). The RSC represents a basic step in organizing the ENEA data bank (1,2, 3) for the registration and processing of reliability data on typical fast reactor components; it provides a functional component breakdown and represents a plant-unique identification in the process of homogenization of event-data coming from different reactors. Different generations of nuclear power plants, different plant layouts and solutions are taken into account. Loop and pool reactors are separately treated.

42014 (FEI–1896) **Conjugation of solutions of radiation transport equation in the problems of radiation protection calculation. Calculation of heterogeneous shields.** Baranov, O.V.; Korobejnikov, V.V.; Mironovich, Yu.N. and others. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1988. 21p. (In Russian). Order Number DE89635555/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Realization of binding algorithms in MMKFK program complex is discribed. Different methods of solution bindings, obtained in programs, applied for radiation protection and reactor calculation are demonstrated. Numerical results of investigating the effect of shield heterogeneity on the value of sodium activation in the secondary circuit are considered, taking the model of BN-1600 fast reactor protection as an example. It is shown that application of solution binding method enables to reduce sufficiently the calculation time and achieve the required accuracy. 12 refs.; 7 figs.; 5 tabs.

42015 (FRCEA-TH–201) **Study of phase diagrams U - O - Na, Pu - O - Na and U, Pu - O - Na.** Pillon, S. CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France); Laboratoire Leon Brillouin, Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Montpellier-2 Univ., 34 (France). 1989. 172p. (In French). Order Number DE89908105/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

The 3 phase diagrams U - O - Na; Pu - O - Na and U,Pu - O - Na are studied to know thermochemical consequences of interaction of molten sodium with nuclear fuel of fast neutron reactors (U,Pu mixed oxide ceramic). Main techniques used for phase characterization are X-ray diffraction, neutron diffraction and microcalorimetry. The study allowed to improve diagrams, to measure thermal and physical properties of important compounds and to draw some conclusions on the limits of modelling the reaction fuel-sodium by the reaction uranium dioxide-sodium.

42016 (INIS-mf–11937) **Significance of the SNR 300 fast breeder reactor in terms of research policy. Documentation.** BMFT - Pressereferat. Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1 Oct 1988. 61p. (In German). Order Number DE89795480/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The publication consists of the following documents: (1) Compact version of the expert opinion on the benefit to be gained for the research policy of the FRG from the FBR prototype reactor station SNR 300. (2) Speech of the Federal Minister for Research and Technology, Dr. Heinz Riesenhuber, in the German Bundestag (September 22, 1988). (3) Survey of fast breeder reactor development and of the SNR 300. (4) Statement concerning the proposal to use the Kalkar nuclear power station (SNR 300) as a 'waste management facility' for plutonium and other actinides. (5) Reply of the Federal Government to an interpellation filed by the deputies Mr Wetzel, Mr Stratmann, Mrs Tauber, Dr. Daniels (Regensburg), and the parliamentary party of the Greens. (orig./UA).

42017 (INIS-mf–11989, pp. 223) **Application of electrochemical hydrogen meter for studying reactions in liquid sodium.** Gnanasekaran, T. (Indira Gandhi Centre for Atomic Research, Kalpakkam (India). Radiochemistry Programme); Ganesan, V.; Periaswami, G.; Mathews, C.K.; Borgstedt, H.U. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

42018 (NIIAR–5(716)) **Studying the noise characteristics of the BOR-60 reactor parameters.** Efimov, V.N.; Eshchenko, S.N. Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR). 1987. 23p. (In Russian). Order Number DE89635556/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The system for measuring and recording noises of the BOR-60 reactor main technological parameters: neutron flux, primary circuit, coolant flow rate, sodium temperatures at fuel assembly outlets, is considered. Estimations of auto- and cross-correlation functions, autospectral power densities and other statistical noise characteristics of reactor parameters are presented. The dependences of the given characteristics on parameter values and time are investigated. Statistical noise characteristics of sodium temperature are obtained using chromel-sodium thermocouples (TC). It is shown that chromel-sodium TC is characterized by sufficiently lower dead time as compared to chromel-alumel one. Possibility of using statistical noise characteristics of the mentioned parameters for monitoring the BOR-60 reactor core state is concluded. Values of correlation coefficients for: flow-rate-power, power-TC indication, flow-rate-TC indication channels are determined. 7 refs.; 12 figs.; 2 tabs.

42019 (ORNL/M–890) **High-temperature flaw assessment procedure: Interim report.** Ruggles, M.B.; Takahashi, Y.; Ainsworth, R.A. Oak Ridge National Lab., TN (USA); Electric Power Research Inst., Palo Alto, CA (USA). Aug 1989. 107p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89016457/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The current program represents a joint effort between the Electric Power Research Institute (EPRI) in the USA, the Central Research Institute of Electric Power Industry (CRIEPI) in Japan, and the Central Electricity Generating Board (CEGB) in the UK. The goal is to develop an interim high-temperature flaw assessment procedure for high-temperature reactor components. This is to be accomplished through exploratory experimental and analytical studies of high-temperature crack growth. The state-of-the-art assessment and the fracture mechanics database for both types 304 and 316 stainless steels, completed in 1988, serve as a foundation for the present work. Work in the three participating organizations is progressing roughly on schedule. Results to-date are presented in this document. Fundamental tests results are discussed in Section 2. Section 3 focuses on results of exploratory subcritical crack growth tests. Progress in subcritical crack growth modeling is reported in Section 4. Exploratory failure tests are outlined in Section 5. 21 refs., 70 figs., 7 tabs.

42020 **Trench reactor: an overview.** Spinrad, B.I. (Iowa State Univ., Ames (USA)); Rohach, A.F.; Razzaque, M.M.; Sankoorikal, J.T.; Schmidt, R.S.; Lofshult, J.; Ramin, T.; Sokmen, N.; Lin, L.C. *Transactions of the American Nuclear Society (USA),* 57: 316-317 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

Recent fast, sodium-cooled reactor designs reflect new conditions. In nuclear energy these conditions are (a) emphasis on maintainability and operability, (b) design for more transparent safety, and (c) a surplus of uranium and enrichment availability that eases concerns about light water reactor fueling costs. In utility practice the demand is for less capital exposure, short construction time, smaller new unit sizes, and low capital cost. The PRISM, SAFR, and integral fast reactor (IFR) concepts are responses to these conditions. Fast reactors will not soon be deployed commercially, so more radical designs can be considered. The trench reactor is the product of such thinking. Its concepts are intended as contributions to the literature, which may be picked up by one of the existing programs or used in a new experimental project. The trench reactor is a thin-slab, pool-type reactor operated at very low power density and- for sodium-modest temperature. The thin slab is repeated in the sodium tank and the reactor core. The low power density permits a longer than conventional core height and a large-diameter fuel pin. Control is by borated steel slabs that can be lowered between the core and lateral sodium reflector. Shutdown is by semaphore slabs that can be swung into place just outside the control slabs. The paper presents major characteristics of the trench reactor that have been changed since the last report.

42021 **Technique for monitoring the age of DN precursors during breached-fuel operation in an LMR.** Gross, K.C. (Argonne National Lab., IL (USA)); Strain, R.V. *Transactions of the American Nuclear Society (USA),* 57: 317-318 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

All current and future-design liquid-metal-cooled reactors rely on the detection and monitoring of delayed-neutron (DN) precursors for

annunciation of fuel/cladding defects that allow fuel/sodium contact. Early research at the Experimental Breeder Reactor II (EBR-II) demonstrated the DN precursors from most breached fuel pins do not recoil instantaneously into the coolant. To account for the observed aging of the DN precursors, an isotopic-holdup time T_h was introduced and defined to be the mean decay time for DN precursors between their birth in the fuel and their release to the coolant. A significant shortcoming of the experimental technique devised to infer values of T_h was that it could be applied only to steady-state DN signals. Thus, if the reactor power, flow rate, or sodium temperature were changing, there has been no way of exploring the behavior of T_h. To overcome this limitation the authors have developed a dual-detector technique, which analyzes data from two DN-detector (DND) locations having different sodium transport times. Such an arrangement is possible in EBR-II when a breached pin is irradiated under the breached-fuel test facility (BFTF). This paper establishes the technical basis for monitoring the ratio of the net signals from two DNDs to track the dynamic behavior of T_h during times when reactor conditions or breach characteristics are changing.

42022 **Noise data management using commercially available data-base software.** Damiano, B. (Oak Ridge National Lab., TN (USA)); Thie, J.A. *Transactions of the American Nuclear Society (USA),* 57: 319-321 (1988). (CONF-881011--: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

A data base has been created using commercially available software to manage the data collected by an automated noise data acquisition system operated by Oak Ridge National Laboratory at the Fast Flux Test Facility (FFTF). The data base was created to store, organize, and retrieve selected features of the nuclear and process signal noise data, because the large volume of data collected by the automated system makes manual data handling and interpretation based on visual examination of noise signatures impractical. Compared with manual data handling, use of the data base allows the automatically collected data to be utilized more fully and effectively. The FFTF noise data base uses the Oracle Relational Data Base Management System implemented on a desktop personal computer.

42023 **Development of an on-line core performance evaluation system for the LMFBR Monju.** Sawada, S.; Ogawa, T.; Shiina, A. *Transactions of the American Nuclear Society (USA),* 57: 321 (1988). (CONF-881011--: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

It is important to know the in-core circumstances precisely in order to operate a reactor core safety and efficiently. The Japanese prototype liquid-metal fast breeder reactor (LMFBR) Monju, which generates 280 MW of electric power and is now under construction, has relatively stable neutron flux distribution. Therefore, the neutron flux level is monitored by ex-vessel neutron detectors, and in-core neutron flux and power distributions are evaluated by an on-line core performance evaluation system. The system is constructed on a process computer placed at the site, which calculates power and temperature distributions and monitors the in-core circumstances and predicts the change of power and temperature distributions due to control rod operations, etc. This paper describes the application programs developed for the system. The models mentioned are expected to offer the prospect that the core performance evaluation system for Monju fulfills their functions from the standpoint of accuracy, calculation time, and computer storage.

2106 Power Reactors, Auxiliary, Mobile, Package, and Transportable

42024 **Transient response of a rectangular cavity to pulsed gravity conditions.** Davis, F.J. Jr.; Hassan, Y.A. *Transactions of the American Nuclear Society (USA),* 57: 374-375 (1988). (CONF-881011--: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

Increasing space engineering applications necessitates a complete and thorough understanding of fluid flow in low-gravity environments. To identify and clearly define meaningful low-gravity fluid problems it is necessary first to study the effects of gravity and its consequences on fluids. Heat transfer through fluids in a closed container at nominal gravity is under extensive study. The influence of gravitational magnitude and direction on natural convection is the subject of previous study. This paper analyzes the fluid transient response to a step change in gravitational magnitude. Such a transient response will play a critical role in safety analyses of nuclear space reactors as this situation will result from any change in the orbit of the reactor station. The case described in this paper indicates overshoot and undershoot in heat transfer during a change in natural convection transient. There also is a finite time, governed by some time constant, for reaching new steady-state conditions.

42025 **Two-dimensional fluidized bed with a jet and immersed obstacle predictions under normal and microgravity conditions.** Vincendon, I.R. (Texas A & M Univ., College Station (USA)); Hassan, Y.A. *Transactions of the American Nuclear Society (USA),* 57: 375-376 (1988). (CONF-881011--: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

Fluidized bed is one of the many reactor types employed in the industry for carrying out gas/solid reactions. In nuclear engineering it can provide a high rate of heat transfer. A study of the influence of gravity has been performed for a two-dimensional rectangular fluidized bed having a high-speed central jet with a rectangular obstacle above it with a secondary airflow. Various gravity values and their influence on the bed expansion, the oscillatory period, and the minimum fluidization velocity were investigated. In the study, a two-dimensional code (FLUFIX/MOD1) for applications of fluid flow simulation in fluid-solids system was used. A fluidized bed is inherently oscillatory with no true steady state ever achieved. Thus, the computer modeling is time dependent. Hydrodynamic models of fluidization use the principles of conservation of mass, momentum, and energy. Six dependent variables are computed: porosity, pressure drop, and the gas and solid velocity in the two directions. It is concluded that the minimum fluidization velocity decreases with decreasing gravity. The bed expansion is longer for low-gravity environments; however, the oscillatory period decreases with increasing gravity.

2107 Regulation and Licensing

Refer also to citation(s) 41998, 42052, 42056, 42063, 42064

42026 (NUREG–0304-Vol.14-No.1) **Regulatory and technical reports (Abstract Index Journal): Compilation for first quarter 1989, January–March.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. Jul 1989. 52p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A04/MF A01 - GPO - OSTI.

This journal includes all formal reports in the NUREG series prepared by the NRC staff and contractors; proceedings of conferences and workshops; as well as international agreement reports. The entries in this compilation are indexed for access by title and abstract, secondary report number, personal author, subject, NRC organization for staff and international agreements, contractor, international organization, and licensed facility.

42027 (NUREG–0936-Vol.8-No.2) **NRC Regulatory Agenda: Quarterly report, April–June 1989.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. Jul 1989. 127p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A07/MF A01 - GPO - OSTI.

This document is a compilation of all rules on which the NRC has proposed or is considering action and all petitions for rulemaking which have been received by the Commission and are pending disposition by the Commission. The Regulatory Agenda is updated and issued each quarter.

42028 (NUREG/CR–2000-Vol.8-No.6) **Licensee Event Report (LER) compilation: For month of June 1989.** Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data; Oak Ridge National Lab., TN (USA). Jul 1989. 97p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. (ORNL/NSIC–200-Vol.8-No.6). Available from NTIS, PC A05/MF A01 - GPO - OSTI.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-0161, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 — Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983. NUREG-1022, Licensee Event Report System — Description of Systems and Guidelines for Reporting, provides supporting guidance information on the revised LER rule. The LER summaries in this report are arranged alphabetically by facility name and then chronologically by event date for each facility. Component, system, keyword, and component vendor indexes follow the summaries. Vendors are those identified by the utility when the LER form is initiated; the keywords for the component, system, and general keyword indexes are assigned by the computer using correlation tables from the Sequence Coding and Search System.

42029 (REG/G–1.147-Rev.7) **Inservice inspection Code Case acceptability: ASME Section XI, Division 1.** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. Jul 1989. 7p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A02/MF A01 - GPO - OSTI.

Section 50.55a, "Codes and Standards," of 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," requires, in part, that each operating license for a boiling or pressurized water-cooled nuclear power facility and each construction permit for a utilization facility be subject to the conditions in paragraph (g), "Inservice Inspection Requirements," of § 50.55a. Paragraph (g) requires, in part, that Classes 1, 2, and 3 components and their supports meet the requirements of Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code or equivalent quality standards. Paragraph 50.55a(b), in part, references the latest editions and addenda in effect of Section XI of the Code and any supplementary requirements to that section of the Code. This regulatory guide lists those Section XI ASME Code Cases that are generally acceptable to the NRC staff for implementation in the inservice inspection of light-water-cooled nuclear power plants.

2108 Economics

Refer also to citation(s) 41754

42030 (INIS-mf–11503, pp. 36-39) **Fuel cycle scanning with the NOREX code.** Segev, M.; Kimhi, Y.; Galperin, A. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Summary only.

42031 (INIS-mf–11503, pp. 71) **Small passive US advanced light water reactor review and considerations from an Israeli viewpoint.** Kidron, A.A. (Israel Electric Corp. Ltd., Haifa (Israel)); Kis, I.; Marouani, D. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Summary only.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory and Calculation

Refer also to citation(s) 42004, 42075

42032 (INIS-mf–11503, pp. 40-44) **Convergence of finite element transport calculations for the analysis of reactor lattices.** Rothenstein, W. (Technion-Israel Inst. of Tech., Haifa (Israel). Dept. of Nuclear Engineering). Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

In this paper some recent studies of the convergence of finite element calculations will be discussed in the case of a resonance absorption calculation in a reactor fuel unit cell. The ultimate aim is to determine whether averages of the upper and lower bounds can be relied upon as converged results for relatively low orders in a P_l flux expansion, so that they can be applied reliably to the study of heterogeneity effects, with modern computing facilities, in a variety of problems both in the thermal and epithermal energy regions.

42033 (INIS-mf–11503, pp. 53-55b) **^{233}U data testing of integral experiments.** Perel, R.L. (Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics); Salmi, U.; Wagschal, J.J. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

The work presented here is part of an effort to generate a modern version of an adjusted cross section library. Seven critical mass measurement integral experiments involving ^{233}U have been considered. These include a bare metallic ^{233}U sphere, three spherical cores intimately surrounded by oralloy shells of various thickness, and three surrounded by natural uranium shells. Some of these integral experiments are by now CSEWG data testing benchmarks and all of them are well documented. In conclusion, the ENDF/B-IV data for ^{233}U were found to be inadequate for reactivity calculations of fast assemblies. The ENDL-84 file on the other hand leads to a much better agreement between measured and calculated reactivities, mainly due to changes in the fission cross section and in the neutron yield.

42034 **Vapor pressure measurements on liquid uranium oxide and (U,Pu) mixed oxide.** Breitung, W. (Kernforschungszentrum Karlsruhe, P.O. Box 3640, 75 Karlsruhe 1 (DE)); Reil, K.O. *Nuclear Science and Engineering (USA),* 101: 26-40 (Jan 1989).

Newly developed in-pile techniques were used to measure the saturation vapor pressure of pure $UO_{2.01}$, reactor grade $UO_{2.08}$, and reactor grade $(U_{0.77}Pu_{0.23})O_{2.09}$ between 2000 and 3700 kJ/kg. The results for all three fuel types can be described by log $rho_{sat}(z) = -9.7652 + 8.0934 \times 10^{-3}z - 2.0515 \times 10^{-6}z^2 + 1.9013 \times 10^{-10}z_3$ with $z = h\text{-}h_{298}$ in kilojoules per kilogram and rho_{sat} in megapascals. The data were converted to the pressure-temperature format and compared to earlier out-of-pile vapor pressure measurements. All out-of-pile measurements that were performed close to a vapor-liquid equilibrium state agree very well with the in-pile results. The following relation is proposed for the rho-T saturation line of liquid UO_2: log $rho_{sat}(T) = 15.961 - 26974/T - 2.7600$ log T with rho_{sat} in megapascals and T in degrees kelvin. Because no significant differences were found for all three fuel types investigated, the same saturation vapor pressure is recommended for liquid-metal fast breeder reactor (LMBFR) typical (U,Pu) mixed oxides under LMFBR core disassembly conditions.

42035 **A hybrid collocation-Galerkin-S_n method for solving the Boltzmann transport equation.** Morel, J.E. (9520845). *Nuclear Science and Engineering (USA),* 101(1): 72-87 (Jan 1989).

A hybrid collocation-Galerkin-S_n method for solving the one-dimensional Boltzmann transport equation is presented. For problems with highly anisotropic scattering, this method offers many advantages relative to the standard S_n method. It is particularly useful for charged-particle calculations and can be implemented

easily in standard S_n codes without changes to the standard solution algorithm. The hybrid method is compared with the standard method both theoretically and computationally.

42036 Evaluation of correlated data using partitioned least squares. Muir, D.W. (Los Alamos National Lab., Applied Nuclear Science Group, Mail Stop B243, Los Alamos, NM (US)). *Nuclear Science and Engineering (USA),* 101(1): 88-93 (Jan 1989).

Optimum procedures for the statistical improvement, or adjustment, of an existing data evaluation are redeveloped from first principles, consistently employing a minimum-variance viewpoint. A set of equations is derived that provides improved values of the data and their covariances, taking into account information from supplementary measurements and allowing for general correlations among all measurements. The minimum-variance adjustment equations thus obtained are found to be equivalent to a method suggested by Linnik and applied by a number of authors to the analysis of fission reactor integral experiments. The minimum-variance solution is also shown to give the same results as the commonly applied normal equations, but with reduced matrix inversion requirements. Examples are provided to indicate some potential areas of application.

42037 Uncertainties of the ENDF/B-V ^{238}U unresolved resonance parameters in the range 4 keV < E < 45.18 keV (MAT = 1398, MF = 2, MT = 251). DeSaussure, G. (9501903); Marable, J.H. *Nuclear Science and Engineering (USA),* 101(3): 285-292 (Mar 1989).

It is a common practice in ENDF/B to represent neutron cross sections in the unresolved resonance region by specifying the average values and distribution laws of resonance parameters. This formalism allows the calculation of resonance self-shielding and of the variation of resonance self-shielding with temperature, two important reactor parameters. For many applications it is necessary to estimate the uncertainties in these model average resonance parameters. A possible approach to derive such uncertainties is described, using as an example the ENDF/B-V representation of ^{238}U in the range from 4 to 45 keV.

42038 Application of point kinetics equations to the design of a reactivity meter. Binney, S.E. (Oregon State Univ., Corvallis (USA)); Bakir, A.J.M. *Transactions of the American Nuclear Society (USA),* 57: 312-314 (1988). (CONF-881011--: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

The time-dependent reactivity of a nuclear reactor is obviously one of the most important reactor parameters that describes the state of the reactor. Although several different types of techniques exist to measure reactivity, only the kinetic method is described here. The paper illustrates the measured reactor power and calculated reactivity for a 70 cents step change in reactivity. These data were taken at 1-s time intervals. It is seen that the reactivity, initially at zero, rises rapidly to a predetermined value (determined by the reactivity change induced in the system) and then returns to zero as the reactor is reestablished in a critical situation by insertion of another control rod. It is concluded that the method of Tuttle has been adapted to produce a reliable, on-line calculation of reactivity from a time-dependent reactor power signal.

42039 Analytic solution for the subcooled flow quality. Lellouche, G.S. *Transactions of the American Nuclear Society (USA),* 57: 345-346 (1988). (CONF-881011--: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

One of the problems with model development and correlation validation is that so few things are measured. Generally, wall temperatures, pressures, and void fraction and the inlet conditions are obtained; all else must be inferred. Each such inference usually requires the assumption of a specific model or constitutive relation, which then becomes a bias on the rest of the interpretation. For example, in developing a mechanistic model for subcooled vapor generation, the phasic split in energy, the wall heat flux, and the relation between flowing quality and void fraction are required. It has been customary to introduce a so-called profile-fit model relating the flowing and equilibrium qualities as one way of avoiding the necessity of introducing a mechanistic subcooled boiling model, but even then the void/quality relation must still be assumed. The authors establish a subcooled boiling model, reduce it to a single nonlinear ordinary differential equation, and note that it is integrable for a uniform wall heat flux. The result provides an exact profile fit model. Specifying a particular set of heat transfer coefficients, the model is compared with two-phase data for cocurrent vertical upflow along with two standard profile fit models. The two-phase data are reduced to a form that permits comparisons by means of a previously validated mechanistic model and drift flux correlation.

2202 Components and Accessories

Refer also to citation(s) 41919, 41967, 41988, 41997, 42007, 42008, 42009, 42010, 42013, 42444, 42449, 42678, 42998

42040 (CLM-R-285) **Review of the available modelling of mixing in subcooled water.** Fletcher, D.F. UKAEA Culham Lab., Abingdon (UK). Feb 1989. 20p. Available from H.M. Stationery Office, London, price Pound 8.00.

In this paper we review the available models of melt/water mixing, for the situation where the water is subcooled. We present both simple analysis and experimental data to illustrate why water subcooling is important. We also examine the related issue of vapour superheating. We then present the conservation equations which describe this situation and the constitutive relations currently available. Finally, we draw some conclusions about the current state of knowledge in this area. (author).

42041 (DOE/NE/37949-T3) **Sensor controlled robotic welding for nuclear power plant operations: Final progress report.** Chin, B.A. Auburn Univ., AL (USA). Dept. of Materials Engineering. 8 Jun 1989. 97p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract FG05-85NE37949. Order Number DE89016089/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The objective of the proposed research is to apply real time monitoring, artificial intelligence and on-line correction to dynamically control the depth of weld penetration and weld integrity during the welding process. Welding is a major technique used in the fabrication, construction and maintenance of power generating and energy conversion systems. In the welding process, fluctuations in process variables lead to weld defects such as lack of penetration, cracks, porosity and undesirable metallurgical structures. This research will apply advanced infrared sensing techniques which have been successfully used in seam tracking to the equally complex problem of weld defect and weld puddle penetration control. Thermal temperature distributions of plates being welded will be dynamically measured during welding using infrared techniques. These temperature distributions will be used to interpret changes in the size and shape of the molten metal pool and the presence of conditions that may lead to defects in the solidified weld. The ultimate result of this research will be the development of machines which are capable of sensing and altering process variables to eliminate defective welds and increase the productivity of the welding process. Successful completion of this proposed research will lead to potential major improvements in the fabrication, construction and maintenance of advanced nuclear reactors and promote increased safety and reliability while decreasing construction costs. 47 refs., 50 figs.

42042 (ENEL-SI-827-87) **Optimal dewatering schemes in the foundations design of an electronuclear plant.** Galeati, G.; Gambolati, G. Ente Nazionale per l'Energia Elettrica, Trino Vercellese (Italy); Padua Univ. (Italy). Jun 1987. 34p. Order Number DE89761972/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A 3-D finite element model combined with an optimization approach based on linear mixed integer programming is developed and applied to assist in the design of the dewatering system for the electro-nuclear plant to be built by the Italian Electric Agency (ENEL) in Trino Vercellese, Northwestern Italy. The site of the foundations is encompassed by a 25-35 m deep plastic wall with the purpose of protecting the unconfined aquifer from significant water table lowering as required by the construction project. To further reduce the propagation of the depression cone, a large amount of the water pumped out is reinjected through "ad hoc" recharge ditches.

The f.e. optimization model includes both the natural and the artificial constraints and provides several optimal withdrawal strategies for the dewatering system design which concern the distribution of the abstraction wells and the corresponding pumping rates. Physical and economical objective functions are explored and the related solutions are discussed.

42043 (FEI–1897) **One-dimensional model of impurity deposition in steam generating tubes.** Anisimov, V.V.; Kashcheev, V.M.; Muranov, Yu.V.; Yur'ev, Yu.S. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1988. 15p. (In Russian). Order Number DE89635468/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The one-dimensional mathematical model of impurity transport and precipitation in steam-generating vertical tubes under dispersion-ring and dispersion conditions of steam-water mixture flow is suggested. The model permits to calculate impurity concentration in a film and in a flow core over the channel length, as well as impurity precipitation flow. The results of testing calculations are presented. 13 refs.; 4 figs.

42044 (FEI–1901) **Azimuthal non-uniformity of velocity field in a nuclear reactor sinking slit.** Leonchuk, M.P.; Shvetsov, Yu.E.; Shvetsova, L.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1988. 11p. (In Russian). Order Number DE89635469/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Results of calculations of coolant velocity field in a nuclear reactor sinking slit are carried out. It is shown that complex motion regimes of a coolant are formed in an annular sinking slit. Dependence of azimuthal non-uniformity on the sinking slit geometrical characteristics is investigated. The calculated results are compared with available in literature experimental data. 3 refs.; 5 figs.; 4 tabs.

42045 (INIS-mf–11503, pp. 101-105) **Optimum sensor location for monitoring mechanical vibrations. A set-theoretical approach.** Ben-Haim, Y. (Technion-Israel Inst. of Tech., Haifa (Israel). Dept. of Nuclear Engineering). Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

The vibrations of a mechanical system can be monitored to assess the operational integrity of the system. In this study we address the question of sensor location without assuming knowledge of the probabilistic properties of the vibrational excitations. The result of our analysis is a method for determining the number and locations of sensors which assure detection of special variations in the amplitude of the vibrational excitation functions.

42046 (OH–84-276-K) **Microbial speciation and biofouling potential of cooling water used by Ontario Hydro.** Sharpe, V.J. Ontario Hydro, Toronto, ON (Canada). Research Center. Feb 1985. 56p. Order Number DE89635470/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

The cooling water composition and microbial components of biofilms attached to stainless steel wafers submerged in three lake water types were evaluated to determine whether their biofouling potential differed in a predictable manner. The composition of the lake waters was different which affected biofilm composition, where the predominance of specific microbial groups varied between test systems and with time. Some prediction of biofouling potential was possible, and it was concluded that the cooling water in the vicinity of Bruce NGS had the lowest biofouling potential whereas greater biofouling could be expected in the Pickering and Nanticoke stations.

2203 Fuel Elements

Refer also to citation(s) 41965, 42088

42047 (FEI–1907) **Algorithm for numerical calculation of thermal-hydraulic parameter distribution in a fuel assembly based on by-channel calculational technique for unsteady operational conditions.** Sorokin, A.P.; Zhukov, A.V.; Kriventsev, V.I.; Titov, P.A.; Ushakov, P.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1988. 16p. (In Russian). Order Number DE89635477/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Descritpion of methods and algorithm of solving a system of equations of pulse, energy and mass macrotransfer in frames of by-channel thermal-hydraulic calculational technique, as well as algorithm of approximate calculation of the temperature of fuel can and in the center of a fuel pellet for unsteady operational conditions are presented. Three-dimensional macrotransfer equations are approximated according to inexplicit finite-difference diagram for the rate-pressure-enthalpy variables taking account of varied physical properties. Algorithm consists in realization of by-step procedure over the time variable with each step iterations. The fuel element temperature is determined in solving the equation of fuel element thermal conductivity on the basis of time profile approximation by power dependence. 9 refs.; 2 figs.

42048 (FEI–1914) **Interchannel transfer and temperature fields in a model fuel assembly of a fast reactor for cross section blockage.** Zhukov, A.V.; Matyukhin, N.M.; Rymkevich, K.S.; Shul'ts, V.; Mashek, V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1988. 13p. (In Russian). Order Number DE89635478/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Results of studying coolant flow distribution in a fast reactor blocked fuel assembly are presented. Local regularities of coolant flow over the perimeter and length of characteristic elements are detected. On the basis of measurement results interchannel exchange coefficients are calculated. The effect of cross section blockage on temperature fields in a model fuel assembly is shown. Maximum nonuniformities of side element temperatures are estimated. 6 refs.; 14 figs.

42049 (NIIAR–6(737)) **Problems of developing the distributed control system for fuel element fabrication automation.** Budnikov, V.N.; Fedorov, Yu.D.; Kashkirov, A.A. Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR). 1988. 17p. (In Russian). Order Number DE89635480/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Specific features of distributed control system are studied. The peculiarities of data processing in this system are considered taking as an example the distributed on-line control system of technological parameters for a fuel element fabrication line. The structure, organization and functions of the SIROD distributed on-line control system are described. 10 refs.; 6 figs.

2204 Control Systems

Refer also to citation(s) 42011, 42090, 42134, 42146, 42149

42050 (AECL–9202) **Fault tree analysis of a research reactor. Computer tools that work.** Hall, J.A.; O'Dacre, D.F.; Chenier, R.J.; Arbique, G.M. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Aug 1986. 15p. (CONF-8605367–: Canadian conference on industrial computer systems, 28 May 1986). Order Number DE89635484/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Fault Tree Analysis Techniques have been used to assess the safety system of the ZED-2 Research Reactor at the Chalk River Nuclear Laboratories. This turned out to be a strong test of the techniques involved. The resulting fault tree was large and because of inter-links in the system structure the tree was not modularized. In addition, comprehensive documentation was required. After a brief overview of the reactor and the analysis, this paper concentrates on the computer tools that made the job work. Two types of tools were needed; text editing and forms management capability for large volumes of component and system data, and the fault tree codes themselves. The solutions (and failures) are discussed along with the tools we are already developing for the next analysis.

42051 (FEI–1918) **Program mock-up of a system for NPP prompt monitoring.** Kupriyanov, V.M.; Makarova, I.N.; Mogil'ner,

A.I. and others. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1988. 17p. (In Russian). Order Number DE89635485/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The increase of safety of NPP operation requires the promotion of automation means for the plant control. The system of operator support are the means intensively developed today to increase monitoring quality. The program mockup is designed to check and debug the principles of designing the system for prompt monitoring, being one of a variant of the operator support system. The mock-up is based on the DVK-2 microcomputer or SM-4 minicomputer and is the program package operating under the control of a special monitor. The system can operate in two regimes: tuning and diagnosis. During tuning the system preparation to operation and adoptation to the certain installation occurs. Data acquisition and correction, file record, primary processing, state identification, diagnostic information and recommendation output are made during diagnostics. All mock-up programs are connected through the data base and a general region of immediate access store. Such a structure of the system permits to change the system composition flexibly when the programs are independent of data and each other. 11 refs.; 3 figs.

42052 (INFO–0225) **Report on human factors in nuclear safety.** Atomic Energy Control Board, Ottawa, ON (Canada). Advisory Committee on Nuclear Safety. Mar 1983. 16p. (In English, French). (ACNS–6). Order Number DE89635486/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

French version included.

Following the Three Mile Island incident of 1979, studies were undertaken by the Atomic Energy Control Board (AECB), in-house and through outside consultants, to address the role of human factors in the regulatory process. This report by the Advisory Committee on Nuclear Safety (ACNS) comments briefly on these studies and offers suggestions which would promote a more formal treatment of human factors by the AECB.

42053 (INFO–0226) **Proposed regulatory policy statement on human factors requirements in the design and operation of Canadian nuclear facilities.** Atomic Energy Control Board, Ottawa, ON (Canada). Advisory Committee on Nuclear Safety. Oct 1986. 16p. (In English, French). (ACNS–9). Order Number DE89635487/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

French version included.

With the increasing complexity of new nuclear facilities and the extent to which automation is being applied, it is essential that the staff who operate a facility be considered as integral components in the design and safety analyses. This policy statement is proposed to indicate those areas of facility design and operation where the role of the human operator must be especially examined.

42054 (INIS-mf–11503, pp. 86) **Application of expert system techniques in nuclear power plants. Brief review of current status and future prospects.** Boger, Z. (Israel Atomic Energy Commission, Beersheba (Israel). Nuclear Research Center-Negev). Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Summary only.

42055 (INIS-mf–11503, pp. 106-109) **Early short-term management of control-actuator failures in a linear dynamic system.** Ben-Haim, Y. (Technion-Israel Inst. of Tech., Haifa (Israel). Dept. of Nuclear Engineering). Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Early short-term management of malfunction attempts to maintain system stability during the early development stages of a failure. This is achieved in two stages. First, the failure is partially diagnosed by comparing observed system behavior against the performance expected for each of the selected set of hypothesized malfunctions. Second, the normal controller is replaced by a compensatory controller whose aim is to maintain system stability while compensating for the failure. Malfunctions involving control actuators are studied here. The aim of this study is to develop a technique for choosing the set of hypothesized failures and compensatory controllers which assure that the state of the system remains within specified bounds for a given duration after initiation of failure, regardless of the precise temporal development of the failure.

42056 (NUREG–1229) **Regulatory analysis for resolution of USI A-17: Systems interactions in nuclear power plants.** Thatcher, D.F. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution. Aug 1989. 18p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A03/MF A01 - GPO - OSTI.

This report presents a summary of the regulatory analysis conducted by the NRC staff to evaluate the value and impact of potential alternatives for the resolution of Unresolved Safety Issue (USI) A-17, "Systems Interactions in Nuclear Power Plants." The NRC staff's proposed resolution offered in this report is based on this analysis. The staff's technical finding regarding interactions can be found in NUREG-1174. Adverse systems interactions (ASIs) involve subtle and often very complicated plant-specific dependencies between components and systems, possible compounded by inducing erroneous human intervention. The staff has identified actions to be taken by licensees and the NRC to resolve USI A-17; the staff has also made the judgment that these actions, together with other ongoing activities, would reduce the risk from adverse systems interactions. As discussed further in this report, the staff judgment that the actions are sufficient is not based on the assertion that all systems interactions have been identified, but rather that the A-17 actions, plus other activities by the licensees and staff, will identify precursors to potentially risk-significant interactions so that the action can be taken if deemed necessary.

42057 (NUREG/CR–5348) **Man-machine interface issues in nuclear power plants.** DeBor, J.; Swezey, R. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Science Applications International Corp., McLean, VA (USA). Jul 1989. 44p. Sponsored by Nuclear Regulatory Commission. (SAIC–89/1114). Available from NTIS, PC A03/MF A01 - GPO - OSTI.

The US Nuclear Regulatory Commission Office of Nuclear Regulatory Research held a workshop on nuclear power plant man-machine interface issues in Bethesda, Maryland, January 10 to 12, 1989. The objective of the workshop was to address potential effects of introducing advanced technology nuclear power plant systems on plant operators and system interface design. The workshop was attended by approximately 50 leading experts respresenting a broad range of applicable disciplines. The workshop resulted in proposed man-machine interface criteria and guidelines, as well as verification and validation experiments. 17 refs.

42058 Human factors considerations for expert systems in the nuclear industry. Nelson, W.R. (9502158). vp. of Proceedings of the 1988 IEEE fourth conference on human factors and power plants. Hagen, E.W. IEEE Service Center, Piscataway, NJ (1988). (CONF-880633–: 4. international conference on human factors and power plants, Monterey, CA (USA), 5-8 Jun 1988).

This paper discusses the general human factors issues relative to the development and implementation of expert systems for the nuclear industry. It summarizes the relevant research that addresses these issues, and identifies those areas that need the most effort for success. Since much of the prominent work for the application of expert systems has focused on computerized aids for decision making in emergencies, this paper draws from this area for its examples. This area tends to highlight the issues because of the safety-critical nature of the application. The same issues, however, are relevant to other applications of expert systems in the nuclear industry as well, even though the consequences of failure may not be as dramatic.

42059 Operator model-based design and evaluation of advanced systems. Schryver, J.C. (Reliability and Human Factors Group, Engineering Physics and Mathematics Div., Oak Ridge National Lab., Building 6025, P.O. Box 2008, Oak Ridge, TN (US)).

vp. of Proceedings of the 1988 IEEE fourth conference on human factors and power plants. Hagen, E.W. IEEE Service Center, Piscataway, NJ (1988). (CONF-880633–: 4. international conference on human factors and power plants, Monterey, CA (USA), 5-8 Jun 1988).

A multi-level operator modeling approach is recommended to provide broad support for the integrated design of advanced control and protection systems for new nuclear power plants. Preliminary design should address the symbiosis of automated systems and human operator by giving careful attention to the roles assigned to these two system elements. A conceptual model of the operator role is developed in the context of a command control-communication problem. According to this approach, joint responsibility can be realized in at least two ways: sharing or allocation. The inherent stabilities of different regions of the operator role space are considered.

42060 Operator model-based design and evaluation of advanced systems. Schryver, J.C. (Reliability and Human Factors Group Engineering Physics and Mathematics Div., Oak Ridge National Lab., Building 6025, P.O. Box 2008, Oak Ridge, TN (US)). vp. of Proceedings of the 1988 IEEE fourth conference on human factors and power plants. Hagen, E.W. IEEE Service Center, Piscataway, NJ (1988). (CONF-880633–: 4. international conference on human factors and power plants, Monterey, CA (USA), 5-8 Jun 1988).

A multi-level operator modeling effort is recommended to provide broad support for integrated design of advanced control and protection systems for new nuclear power plants (NPP). A computational model is described which accounts for the cognitive activities of the operator by combining the advantages of network simulation and knowledge-based simulation. The Integrated Reactor Operator/System (INTEROPS) model is a time-based simulation model which can be coupled with, and control, a thermal-hydraulics model of a nuclear power plant. The INTEROPS model can provide fine-grained evaluation of allocation of functions during the iterative design phase of advanced systems.

42061 Testing of electric motors for monitoring age-related degradations. Subudhi, M. (9504782); Taylor, J.H.; Sheets, M. *Nuclear Technology (USA)*, 84(1): 54-61 (Jan 1989).

A 10-hp industrial motor with 12 yr of service in a commercial nuclear power plant and a 400-hp failed motor with > 20 yr of service life in a nuclear research facility were tested. The 10-hp motor was subjected to plug reverse cycling to induce accelerated aging while various insulation and bearing test parameters were monitored. Stator coils from the 400-hp motor were tested to diagnose age-related deterioration of insulation dielectric properties. The test objectives were to identify cost-effective motor testing methods or functional indicators that provide adequate feedback to detect degradation in motor components. It was found that monitoring and testing methods are available to detect degradation at an incipient stage.

2205 Environmental Aspects

Refer also to citation(s) 41717, 42042, 42101, 42103, 42147, 42148, 43233, 43442, 43512

42062 (GA-A–19702) **Perspectives of modular high temperature gas-cooled reactor (MHTGR) on effluent management and siting.** Dunn, T.; Cardito, J.; Cunliffe, J. General Atomics, San Diego, CA (USA). Jul 1989. 11p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC03-89SF17885. (CONF-890810–3: Seminar on small and medium sized reactors, design, safety and marketing potential, San Diego, CA (USA), 21-23 Aug 1989). Order Number DE89015218/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The MHTGR is an advanced reactor concept being developed under a cooperative program involving the US Government, the utilities and the nuclear industry. The programs objective is the development of an environmentally safe, reliable, and economic nuclear power option for the USA and other nations of the world. HTGR design features, such as the ceramic fuel, helium coolant, and graphite moderator, are incorporated into the MHTGR reference plant design which incorporates four 350 MW(t) reactor modules. This papers objective is to describe those plant features, which minimize the environmental impact of MHTGR operation through efficient energy production, management of normal plant non-radioactive/radioactive effluents, and inherent characteristics and passive safety features which ensure benign plant site suitability source terms. 16 refs.

42063 (INFO–0272) **Suspended solids in liquid effluents. A literature survey.** McGrath, J.J. Atomic Energy Control Board, Ottawa, ON (Canada). Jun 1988. 89p. Order Number DE89635123/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

An international literature review and telephone mail survey was conducted with respect to technical and regulatory aspects of suspended solids in radioactive liquid wastes from nuclear power stations. Results of the survey are summarized and show that suspended solids are an important component of some waste streams. The data available, while limited, show these solids to be associated largely with corrosion products. The solids are highly variable in quantity, size and composition. Filtration is commonly applied for their removal from liquid effluents and is effective. Complex interactions with receiving waters can result in physical/chemical changes of released radionuclides and these phenomena have been seen as reason for not applying regulatory controls based on suspended solids content. 340 refs.

42064 (INFO–0277) **Cost-effectiveness of reduction of off-site dose.** McGrath, J.J.; Macphee, R.; Arbeau, N.; Miskin, J.; Scott, C.K.; Winters, E. Atomic Energy Control Board, Ottawa, ON (Canada). Mar 1988. 187p. Order Number DE89635267/JAW. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

Since the early 1970's, nuclear power plants have been designed and operated with a target of not releasing more than one percent of the licensed limits (derived emission limits) in liquid and gaseous effluents. The AECB initiated this study of the cost-effectiveness of the reduction of off-site doses as part of a review to determine if further measures to reduce off-site doses might be reasonably achievable. Atlantic Nuclear has estimated the cost of existing technology options that can be applied for a further reduction of radioactive effluents from future CANDU nuclear power plants. Detritiation, filtration, ion exchange and evaporation are included in the assessment. The costs are presented in 1987 Canadian dollars, and include capital and operating costs for a reference 50 year plant life. Darlington NGS and Point Lepreau NGS are the reference nuclear power plant types and locations. The effect resulting from the hypothetical application of each technology has been calculated as the resulting reduction in world collective radiation dose detriment. The CSA N288.1 procedure was used for local pathway analysis and the global dispersion model developed by the NEA (OECD) group of experts was used for dose calculations. The reduction in the 'collective effective dose equivalent commitment' was assumed to exist for 10,000 years, the expected life-span of solid waste repositories. No attempt was made to model world population dynamics. The collective dose reductions were calculated for a nominal world population of 10 billion persons. The estimated cost and effect of applying the technology options are summarized in a tabular form for input to further consideration of 'reasonably achievable off-site dose levels'.

42065 (INIS-mf–11513) **Environmental monitoring report for the Point Lepreau, New Brunswick nuclear generating station 1984.** Nelson, R.W.P.; Ellis, K.M.; Smith, J.N. Bedford Inst. of Oceanography, Dartmouth, NS (Canada). Jul 1986. 161p. Order Number DE89635262/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Canadian Technical Report of Hydrography and Ocean Sciences No. 75.

The Point Lepreau Environmental Monitoring Program (PLEMP) has been established within the Department of Fisheries and Oceans to assess the environmental impact of radioactive, thermal, and chemical releases from the Point Lepreau, N.B. Nuclear Generating Station (NGS) located on the Bay of Fundy. This report contains the results for the second year of the operational phase of the monitoring program. Emphasis has been placed on those areas where effects from the NGS operation were expected to be observed. Further studies were carried out on the characterization of the thermal plume during several pre-arranged tritium releases. Attention was given to tritium levels at the outfall, in the atmosphere

and in biological samples. An initial attempt was made to relate the distribution of tritium in the Point Lepreau area in various phases to local meteorological conditions. Radionuclide levels in lichen, including, for the first time, aerial lichen on a regular basis, an efficient accumulator of atmospheric particulates were monitored. In addition, radionuclide measurements were made on samples collected during the pre-operational phase from the major environmental reservoirs and these radioactivity levels were compared to previous measurements to assess the impact of the operation of the NGS. The purpose of this program is to provide government with a comprehensive scientific basis upon which to assess the environmental implications of the operation of nuclear reactors in coastal regions.

42066 (NUREG/CR–5175) **Beta and gamma dose calculations for PWR and BWR containments.** King, D.B. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 221p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (SAND–88-1605). Available from NTIS, PC A10/MF A01 - GPO - OSTI.

Analyses of gamma and beta dose in selected regions in PWR and BWR containment buildings have been performed for a range of fission product releases from selected severe accidents. The objective of this study was to determine the radiation dose that safety-related equipment could experience during the selected severe accident sequences. The resulting dose calculations demonstrate the extent to which design basis accident qualified equipment could also be qualified for the severe accident environments. Surry was chosen as the representative PWR plant while Peach Bottom was selected to represent BWRs. Battelle Columbus Laboratory performed the source term release analyses. The AB epsilon scenario (an intermediate to large LOCA with failure to recover onsite or offsite electrical power) was selected as the base case Surry accident, and the AE scenario (a large break LOCA with one initiating event and a combination of failures in two emergency cooling systems) was selected as the base case Peach Bottom accident. Radionuclide release was bounded for both scenarios by including spray operation and arrested sequences as variations of the base scenarios. Sandia National Laboratories used the source terms to calculate dose to selected containment regions. Scenarios with sprays operational resulted in a total dose comparable to that (2.20×10^8 rads) used in current equipment qualification testing. The base case scenarios resulted in some calculated doses roughly an order of magnitude above the current 2.20×10^8 rad equipment qualification test region. 8 refs., 23 figs., 12 tabs.

42067 (NUREG/CR–5225-Add.1) **An overview of BWR Mark-1 containment venting risk implications: An evaluation of potential Mark-1 containment improvements.** Wagner, K.C.; Dallman, R.J.; Galyean, W.J. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution; EG and G Idaho, Inc., Idaho Falls, ID (USA). Jun 1989. 126p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC07-76ID01570. (EGG–2548-Add.1). Available from NTIS, PC A07/MF A01 - GPO - OSTI.

This report supplements containment venting risk evaluations performed for the Mark-I Containment Performance Improvement (CPI) Program. Quantitative evaluations using simplified containment event trees for station blackout sequences were performed to evaluate potential risk reduction offered by containment venting, and improved automatic depressurization system with a dedicated power source, and an additional supply of water to either the containment sprays or the vessel with a dedicated power source. The risk calculations were based on the Draft NUREG-1150 results for Peach Bottom with selected enhancements. Several sensitivity studies were performed to investigate phenomenological, operational, and equipment performance uncertainties. Qualitative risk evaluations were provided for loss of long-term containment heat removal and anticipated transients without scram for the same set of improvements. A limited discussion is provided on the generic applicability of these results to other plants with Mark-I containments. 23 refs., 15 figs., 13 tabs.

42068 (OH–85-59-K) **Assessment of ichthyoplankton entrainment at Pickering 'A' NGS using a pump/net in lake system.** McKinley, R.S. Ontario Hydro Research Lab., Toronto, ON (Canada). Mar 1985. 16p. Order Number DE89635264/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Annual entrainment at Pickering 'A' NGS was estimated for alewife as 13.6×10^6 larvae and 409×10^6 eggs. A substantial portion of eggs and larvae entering the intake were dead due to natural mortality (41%-81%) prior to entrainment. Viable eggs and larvae, immediately following entrainment showed mortalities of 54% and 44% respectively. The latent mortality of entrained eggs was 100% (48 h).

42069 (OH–85-258-K) **Evaluation of a pilot fish handling system at Bruce NGS 'A'.** Griffiths, J.S. Ontario Hydro Research Lab., Toronto, ON (Canada). Oct 1985. 47p. Order Number DE89635263/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A pilot fish recovery system using a Hidrostal fish pump was tested in the Bruce NGS 'A' forebay during June, 1984. Despite low forebay fish concentrations, the system was capable of capturing 97,000 alewife/day (3900 kg) if operated continuously. Post-pumping survival averaged 97%. It is estimated that a single pump could handle alewife runs in the 40,000 to 70,000 kg range, but multiple pumps or a single larger pump would be required to assure station protection from the largest runs (>100,000 kg). Results indicate that tank/trailer return of pumped fish is feasible, but other alternatives for returning fish to Lake Huron are also being considered.

42070 (OH–87-114-K) **Sensitivity study of the Continuous Release Dispersion Model (CRDM) for radioactive pollutants.** Camacho, F. Ontario Hydro, Toronto, ON (Canada). Research Center. Aug 1987. 109p. Order Number DE89635268/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

The Continuous Release Dispersion Model (CRDM) is used to calculate spatial distribution of pollutants and their radiation doses in the event of accidental releases of radioactive material from Nuclear Generation Stations. A sensitivity analysis of the CRDM was carried out to develop a method for quantifying the expected output uncertainty due to inaccuracies and uncertainties in the input values. A simulation approach was used to explore the behaviour of the sensitivity functions. It was found that the most sensitive variable is wind speed, the least sensitive is the ambient temperature, and that largest values of normalized concentrations are likely to occur for small values of wind speed and highly stable atmospheric conditions. It was also shown that an error between 10% and 25% should be expected in the output values for a 1% overall error in the input values, and this factor could be much larger in certain situations.

2206 Research, Test, and Experimental Reactors

Refer also to citation(s) 42050, 42061, 42086, 42132, 42248

42071 (AECL–9184) **In-reactor deformation of a pilgered cold-worked Zr-2.5 wt% Nb pressure tube.** McManus, M.D.; Causey, A.R. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Oct 1986. 27p. Order Number DE89635563/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Zr-2.5 wt% Nb pressure tubes in CANDU reactors are cold-drawn to achieve the desired mechanical strength and tube dimensions. As part of an assessment of possible alternative fabrication processes, a pressure tube was cold-worked by pilgering and its dimensional stability monitored during service in the U-1 loop in the NRU test reactor. Strain rates have been determined for the pilgered tube from measured diameter and length changes after 22,060 h of reactor operation. These rates were compared with those for a cold-drawn tube also tested in NRU, and with the calculated behaviour of current power reactor pressure tubes extrapolated to the NRU test conditions. The deformation rates of the pilgered tube were found to be only marginally inferior to those of cold-drawn tubes.

42072 (JAERI-M–88-273) **JMTR-operation and technical development no. 2. Fiscal 1985.** Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1989. 186p. (In Japanese). Order Number DE89906497/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

The Department of JMTR Project Performs Operation and maintenance of the JMTR (Japan Materiales Testing Reactor), the HOT

Laboratory associated with the JMTR and the JMTRC (Japan Materials Testing Reactor Critical Facility), and Technical Developments to respond to various irradiation requirements. This document describes the above activities performed in fiscal 1985. (author).

42073 (Juel–2263) **The external neutron guide laboratory ELLA at the FRJ-2 the KFA Juelich.** Duppich, J.; Werner, K. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung. Feb 1989. 94p. (In German). Order Number DE89911498/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The project covered the following main actions: Construction of a new cold source (liquid hydrogen, 22 K, thermosyphon) with an optimized moderator chamber, a cooled (about 50 K) single crystal Bi-filter is built in the beam tube; Lay-out and construction of a neutron guide system, employing ^{58}Ni-coated glass plates, with altogether 4 tubes, one of them being realized by means of a beam bender, at several end-positions focussing guide elements are installed; Lay-out and construction of the corresponding shieldings; Construction of the building, including the experimental hall, which is partly equipped with a special dance-floor, attached electronic rooms, laboratories and facilities for media supply like air-conditioning; Installation of altogether 10 instruments. The implementation of the project took from April 1983 until late 1986. The facilities were erected according to the German Atomic Energy Law. The absolute cold neutron flux at the hall entrance was measured to be 5.4×10^8 n/sec cm^2. This results in a gain factor - compared to the former installation - of about 4. (orig./HP).

42074 (UTNL-R–0227) **Report of the research results with University of Tokyo, Nuclear Engineering Research Laboratory's Facilities in fiscal 1987.** Tokyo Univ., Tokai, Ibaraki (Japan). Nuclear Engineering Research Lab. 1988. 98p. (In Japanese). Order Number DE89906569/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The report of the results of research carried out by the common utilization of the reactor 'Yayoi' and an electron accelerator in the Nuclear Engineering Research Laboratory in fiscal year 1987 is ready. In fiscal year 1987, the research themes using the reactor Yayoi or related to it were 14, and those using the linear accelerator reached 17, thus the common utilization attracted the strong interest of users. The Yayoi has been operated satisfactorily without trouble. The budget for remodeling the control rod driving mechanism which has been a pending was approved, and it is expected to carry out the general overhaul at the end of this fiscal year, placing emphasis on the improvement of the maintainability. On the other hand, as for the linear accelerator, the budget for repair and remodeling was approved from fiscal year 1987, and it is expected that its function is further heightened as a twin linac. However accompanying the repair, sufficient machine time was not allotted to some groups. In this report, the results of the research carried out by the common utilization of the Yayoi and a linac and the reports of 12 Yayoi research meetings in fiscal year 1987 are collected. (K.I.).

42075 Benchmark physics tests in the metallic-fueled assembly ZPPR-15. McFarlane, H.F. (0447000); Brumbach, S.B.; Carpenter, S.G.; Collins, P.J. *Nuclear Science and Engineering (USA)*, 101(2): 137-152 (Feb 1989).

Results of the first benchmark physics tests of a metallic-fueled, demonstration-size liquid-metal reactor (LMR) are reported. A simple, two-zone, cylindrical conventional assembly was built with three distinctly different compositions to represent the stages of the Integral Fast Reactor fuel cycle. Experiments included criticality, control, power distribution, reaction rate ratios, reactivity coefficients, shielding, kinetics, and spectrum. Analysis was done with three-dimensional nodal diffusion calculations and ENDF/B-V.2 cross sections. Predictions of the ZPPR-15 reactor physics parameters agreed sufficiently well with the measured values to justify confidence in design analyses for metallic-fueled LMRs.

42076 Advanced neutron source corrosion test-loop facility. Montgomery, B.H. (Oak Ridge National Lab., TN (USA)); Pawel, R.E.; Yoder, G.L. *Transactions of the American Nuclear Society (USA)*, 57: 300-301 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

The reference core for the advanced neutron source (ANS) will have a configuration similar to the present High-Flux Isotope Reactor (HFIR) at Oak Ridge National Laboratory: simply, an array of aluminum-alloy-clad fuel plates immersed in rapidly flowing water. The high thermal conductivity of the aluminum combined with the high heat transfer coefficient governing heat flow from the plate to the water keep the fuel inside the plates at an acceptable temperature. Unfortunately, the exposed of aluminum under these conditions leads to the formation of a thin layer of oxide (boehmite) that separates the fuel plates from the coolant water. The boehmite film has very poor thermal conductivity, and the heat flux that must cross this film can cause excessive heating of the fuel during the lifetime of the core. A test loop has been built to determine experimentally the rate of corrosion product formation on the aluminum cladding at the higher heat fluxes. Preliminary experiments have been completed that illustrate the capabilities of the loop system and the general behavior of an aluminum specimen exposed to large heat fluxes and coolant velocities. This same facility will be used for thermal-hydraulic testing; however, modifications will be necessary because of higher heat fluxes, temperatures, and pressures. Currently, the design is for light water testing; heavy water tests will be conducted in the future, which will require additional modifications.

2207 Plutonium and Isotope Production Reactors

Refer also to citation(s) 42152

42077 (INIS-SU–106, pp. 22-26) **Hardware solution for intermediate helium circuit of nuclear process-heat plant with HTR.** Syavrikov, A.Ya.; Gokhut, A.F.; En'kov, V.I.; Kruglyanskij, V.Ya.; Veranyan, R.S.; Nazarov, Eh.K.; Nikolaevskij, V.B.; Lotkina, O.S.; Krotov, L.I.; Nikolova, L.Z. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Nuclear-hydrogen energetic and technology. Scientific-technical collection of papers.* Order Number DE89012197/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 1.

The results of design treatment of process heat exchangers and layout solutions of an intermediate helium circuit of a high-temperature reactor are presented. The circuit is designed for producing a hydrogen-containing gas inthe process of methane steam conversion. High-temperature heat (900 deg C) is fed from the HTR reactor via a helium-helium heat exchanger. The versions of horizontal and vertical arrangement of the heat conversion facility, reactor of methane conversion with a catalyst if reaction pipes or in interpipe space, as well as a set of heat-exchange devices are considered. 5 refs.; 6 figs.

2208 Propulsion Reactors

Refer also to citation(s) 42246

2209 Reactor Safety

Refer also to citation(s) 41769, 41957, 41958, 41962, 42004, 42006, 42027, 42029, 42036, 42040, 42052, 42053, 42056, 42057, 42058, 42059, 42060, 42062, 42066, 42067, 42070, 42249, 43233, 44006, 44342

42078 (AECL–9094) **Hydrogen combustion issues and containment integrity.** Tennankore, K.N.; Koroll, G.W.; Kumar, R.K.; Lam, A.H.T.; Chan, C.K.; Wren, D.J. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 30p. Order Number DE89635466/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This report reviews recent results from the research program at the Whiteshell Nuclear Research Establishment aimed at resolving hydrogen combustion issues relevant to reactor containment integrity. The areas considered are hydrogen mixing behaviour, flame propagation, pressure transients caused by deflagration, flame acceleration and transition to detonation. Small-scale tests carried out

with helium/CO_2 systems indicate that the presence of a recirculation path will enhance buoyancy-driven mixing of hydrogen-steam jets with air in the containment. An extensive database has been assembled for the laminar burning velocity of hydrogen-air-steam mixtures. Work is now beginning on obtaining burning velocities under turbulent conditions likely to prevail in containments. Turbulent and vented combustion data obtained in a 2.3-m-diameter spherical vessel have been analyzed. The results indicate that the pressure predictions of a one-dimensional model can be matched with the data if different effective burning velocities are used. Obstacle-induced flame acceleration and transition to detonation have been studied in a small-scale test facility to determine conditions required for transition to detonation in containments. For a repeated obstacle configuration, the obstacle blockage ratio required to cause transition (deflagation to detonation or detonation to deflagration) can be correlated well with detonation cell size. Cell sizes for mixtures of interest are being determined in our laboratory to complement available data. The transition-to-detonation process has been visualized in the above tests by Schlieren photography. The eventual objective of this work is to identify the local conditions controlling the transition process.

42079 (AECL–9097) **Aerosol stratification in containment.** Razzaghi, M. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 26p. Order Number DE89635669/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Fission products are released in aerosol form from nuclear reactors under postulated accident conditions. An understanding of aerosol behaviour is thus important in the estimation of potential radioactivity release from containment. A major simplifying assumption of many models of aerosol behaviour in closed vessels (i.e., containment buildings) is that of spatial homogenity, commonly known as the 'well-mixed' assumption. It is generally argued that this assumption leads to prediction of a conservative (i.e., high) estimate of the total airborne aerosol mass at any time; however, there is no evidence that this is true. This paper focuses on aerosol stratification. Aerosol dynamics are considered in one spatial direction (vertical) and the results are compared with the predictions of the corresponding well-mixed model. The comparison indicates that the well-mixed assumption may not lead to conservative predictions of potential aerosol release from a containment building. Although the model derivations have been based on the flow induced by gravitational force, they can be readily extended to flow induced by other forces, for example, differential pressure.

42080 (AECL–9098) **Assessing physical models used in nuclear aerosol transport models.** McDonald, B.H. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 31p. Order Number DE89635670/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Computer codes used to predict the behaviour of aerosols in water-cooled reactor containment buildings after severe accidents contain a variety of physical models. Special models are in place for describing agglomeration processes where small aerosol particles combine to form larger ones. Other models are used to calculate the rates at which aerosol particles are deposited on building structures. Condensation of steam on aerosol particles is currently a very active area in aerosol modelling. In this paper, the physical models incorporated in the current available international codes for all of these processes are reviewed and documented. There is considerable variation in models used in different codes, and some uncertainties exist as to which models are superior. 28 refs.

42081 (AECL–9099) **Assessing numerical methods used in nuclear aerosol transport models.** McDonald, B.H. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 31p. Order Number DE89635671/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Several computer codes are in use for predicting the behaviour of nuclear aerosols released into containment during postulated accidents in water-cooled reactors. Each of these codes uses numerical methods to discretize and integrate the equations that govern the aerosol transport process. Computers perform only algebraic operations and generate only numbers. It is in the numerical methods that sense can be made of these numbers and where they can be related to the actual solution of the equations. In this report, the numerical methods most commonly used in the aerosol transport codes are examined as special cases of a general solution procedure, the Method of Weighted Residuals. It would appear that the numerical methods used in the codes are all capable of producing reasonable answers to the mathematical problem when used with skill and care. 27 refs.

42082 (BMU–1989-208) **Evaluation of data recordings of documentation systems in nuclear power plants (SABA). Final report.** Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten. Anders, U.; Flor, R.; Gloee, G.; May, M.; Rabe, G.; Burmeister, W.; Eckert, T. Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Technischer Ueberwachungs-Verein Norddeutschland e.V., Hamburg (Germany, F.R.). 1989. 246p. (In German). Contract BMU SR 340. Available from GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

PASCAL; Digital Equipment VMS.

A programme package called SABA (in German: System zur Auswertung binaerer und analoger Kraftwerksmeldungen, i.e. System for Evaluation of Binary and Analogue Data from Power Plants) has been conceptually designed and carried out to analyze the data recordings of documentation systems in nuclear power plants. Programmes are written in the programming language PASCAL. SABA was applied to data recorded by the documentation system of the nuclear power plant 'Kruemmel'. Results: (1) significant information for design, assessment and licensing of documentation systems. This includes, e.g., signal rates, depending on the plant's operational status and on the plant's various equipment; (2) information on the reliability of 'Kruemmel's' documentation systems, e.g., data about the frequency of inconsistencies in the data base supplied by the documentation system; (3) the results revealed insights into the plant's behaviour which was interesting from the operational and safety-related point of view. This includes, e.g., tracing run-times of units and response-times needed by relevant safety-related valves to open or shut. (orig./HP).

42083 (BMU–1989-213) **Description of the MOD2/85 versions of the RALOC/FIPLOC family. Pt. 1. Code system including appendices A and B.** Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten. Jahn, H.; Weber, G.; Pham, T. v. Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.). 1989. 315p. Contract BMU SR 271/2. Available from GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

This report describes the general philosophy of the RALOC/FIPLOC code family, the characteristics and the structure of the codes. The intention is to give an overall impression on the RALOC/FIPLOC code system, which can be applied to general containment problems (such as p-, T-calculation), special distribution considerations in subcompartmented geometries (for example H_2, steam, air), aerosol distribution and behaviour (in containments, auxiliary buildings etc.) and multicompartment combustion (especially hydrogen). One of the major characteristics of these codes consists in the capability to investigate short and long term problems (up to several 100 days) and to calculate pressure and/or buoyancy driven convection within subcompartmented containments or single rooms. The modelling involves free or forced convection or their combination to give information on integral and local conditions. RALOC and FIPLOC are systems codes which may be applied to all types of containments and accidents but possibly also to other industrial or experimental facilities. These codes or further modifications could also be of interest for investigations of transport phenomena in piping systems, such as convection in a primary coolant system of a nuclear power plant during a severe accident. The description of RALOC and FIPLOC is given in a detailed form. (orig./HP).

42084 (CEA-DAS–541e) **French practice for assessing the fission product releases from the containment during a PWR severe accident.** Duco, J.; Dufresne, J.; L'homme, A. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Oct 1988. 27p. (CONF-8809378–: 10. OECD

meeting of work group GTP4, Paris (France), 29-30 Sep 1988). Order Number DE89903157/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

French safety philosophy as concerns severe PWR accidents has already been outlined by the Director of CEA/IPSN in an article published in "Nuclear Safety". Therefore the present paper will focus on: (a) the French reference source terms, as used for elaborating ultimate emergency procedures on PWRs and for emergency planning; (b) the methods currently developed for more realistic assessments of the release of fission products during a severe accident.

42085 (CEA-DAS–582) **Presentation of a method for the sequential analysis of incidents.** Delage, M.; Giroux, C.; Quentin, P. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Apr 1989. 9p. (CONF-8904156–: CSNI-CEC specialist meeting on trends and pattern analyses of operational data from nuclear power plants, Rome (Italy), 3-7 Apr 1989). Order Number DE89903195/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

This paper presents a method which is designed to assist in the analysis of safety and is based on the graphic representation of the occurrence of incidents significant for safety in 900 MWe PWR units. The graphs obtained are linked together to produce a general tree of events. With this tool, and on the basis of operating experience, we are then able to imagine complex incident scenarios, to evaluate the potential consequences of a particular incident or to seek out the causes which could lead to a given event. Interactions between systems or common mode faults can also appear with this method.

42086 (DOE/EH–0093) **Technical Safety Appraisal of the Omega West Reactor, Los Alamos National Laboratory.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (USA). Jul 1989. 215p. Sponsored by U.S. DOE Environment Health & Safety. Order Number DE89015340/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

This report presents the results of the Technical Safety Appraisal (TSA) of the Omega West Reactor (OWR) at Los Alamos National Laboratory (LANL), conducted by the DOE Office of the Assistant Secretary for Environment, Safety and Health, Office of Safety Appraisals, during May 1 to May 26, 1989. TSAs are one of the initiatives announced by the Secretary of Energy on September 18, 1985, to enhance the DOE Environment, Safety and Health Program. The overall safety assessment of the OWR by the DOE Headquarters Office of Safety Appraisals is presented in Section II, PERFORMANCE EVALUATION. The assessment was based on the direct involvement in the appraisal process by a senior Headquarters manager, discussions among Headquarters managers and staff, and consideration of the Appraisal Team's results provided in Section III, REVIEW FINDINGS.

42087 (DOE-RW–88.101) **Chernobyl fallout in Great Britain. Final report.** Horrill, A.D.; Lowe, V.P.W.; Howson, G. Department of the Environment, London (UK). Sep 1988. 88p. Order Number DE89635258/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Chernobyl deposition in the UK was sampled in May and October 1986 and in June of 1987. The sampling concentrated on grassy vegetation but in October 1986 other vegetation, soils and wildlife were included. Deposition patterns have been established and a greater degree of retention and recycling indicated for the organic soils of upland Britain. For wild animals concentration factors varied not only between species but with sex and age. Highest tissue concentrations were recorded in species feeding on heather (Blue hares and Grouse) and the lowest in rabbits feeding on grass over mineral soils. Radiocaesium was found in a carnivore (the fox) at the top of the food chain. (author).

42088 (EGG-EAST–8557) **Metal-water reaction and cladding deformation models for RELAP5/MOD3.** Caraher, D.L.; Shumway, R.W. EG and G Idaho, Inc., Idaho Falls, ID (USA). Jun 1989. 33p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE89016363/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A model for calculating the reaction of zirconium with steam according to the Cathcart-Pawel correlation has been incorporated into RELAP5/MOD3. A cladding deformation model which computes swelling and rupture of the cladding according to the empirical correlations for Powers and Meyer has also been incorporated into RELAP5/MOD3. This report gives the background of the models, documents their implantation into the RELAP5 subroutines, and reports the developmental assessment done on the models. 4 refs., 9 figs., 9 tabs.

42089 (EPRI-NP–6442) **A simplified piping support system with seismic limit stops: Interim report.** Leung, J.S.M.; Anderson, P.H.; McLean, J.L. Electric Power Research Inst., Palo Alto, CA (USA); Cloud (Robert L.) and Associates, Inc., Berkeley, CA (USA). c Jul 1989. 199p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

An innovative method has been developed for providing seismic support to nuclear power plant piping. The method, called the Simplified Pipe Support System (SPSS), is based on the concept of permitting free thermal expansion but limiting seismic displacement through the use of pipe support stops with large clearances (Seismic Stops). The Seismic Stops are simple passive supports and are intended to replace the active snubbers that currently used through the nuclear industry. The development program reported here consisted of establishing a practical analytical method for determining the global nonlinear impact response; characterizing the local impact behavior; evaluating its applicability to current ASME Code criteria; demonstrating the concept through full-scale shake table testing; and lastly; verificating analysis methods by comparison to test data and to analyses of actual piping systems. 19 refs., 43 figs., 28 tabs.

42090 (GRS–71) **Comparative evaluation of methods for human reliability analysis.** Swain, A.D. Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.). Apr 1989. 517p. Available from Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.).

This report compares and evaluates fourteen published methods for human reliability analysis (HRA) for their possible use as part of a probabilistic risk assessment (PRA) of nuclear power plants (NPPs) or other complex machine systems, or as a design tool in all phases of design and development of such systems. The comparison is made on the basis of a procedure called the 'Evaluation Criteria for Selecting HRA Methods' (short title: HRACRIT), which includes a special checklist called the HRACRIT Checklist. The criteria used in HRACRIT consist of three general criteria: usefulness, acceptability and practicality. These general criteria are further divided into specific and detailed criteria. (orig.).

42091 (INIS-mf–11483, pp. 2) **Problems in establishing derived intervention levels for food contamination after a nuclear accident.** Kraus, W. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

42092 (INIS-mf–11483, pp. 10) **Problems of the realization of measuring systems for monitoring of severe accidents in nuclear power plants.** Korn, H. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)); Muenchow, W. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

42093 (INIS-mf–11503 vp.) **Mitigation of the radiological consequences of a nuclear power plant accident by protective measures. An uncertainty analysis.** Koch, J. (Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center); Tadmor, J. Israel Nuclear Society, Yavne (Israel). Mar 1989.

(CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
Transactions.; V. 15.

The uncertainty analysis was performed on two computer models, REMAND probabilistic consequence model (Stern 1987) and RECLEAR evacuation model (Gants 1985). The survey focused on input variables describing the implementation of the protective measures or influencing their effectiveness. Uncertainties were expressed by subjective probability density functions of the values of the input variables. It was found that the distribution effect is significant, when non-specific distributions (normal, uniform) are used instead of the originally assumed distributions.

42094 (INIS-mf–11503, pp. 63-64) **Containment design aspects of severe externally initiated events in commercial power plants.** Kis, I. (Israel Electric Corp. Ltd., Haifa (Israel)). Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
Transactions.; V. 15.
Summary only.

42095 (JAERI-M–89-025) **LOSP-initiated event tree analysis for BWR.** Watanabe, Norio; Kondo, Masaaki; Uno, Kiyotaka; Chigusa, Takeshi; Harami, Taikan. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1989. 108p. (In Japanese). Order Number DE89906500/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

As a preliminary study of 'Japanese Model Plant PSA', a LOSP (loss of off-site power)-initiated Event Tree Analysis for a Japanese typical BWR was carried out based on the open documents such as 'Safety Analysis Report'. Objectives of this analysis are: - to delineate core-melt accident sequences initiated by LOSP, - to evaluate the importance of core-melt accident sequences in terms of occurrence frequency, and - to develop a foundation of plant information and analytical procedures for efficiently performing further 'Japanese Model Plant PSA'. This report describes the procedure and results of the LOSP-initiated Event Tree Analysis. In this analysis, two types of event trees, Functional Event Tree and Systemic Event Tree, were developed to delineate core-melt accident sequences and to quantify their frequencies. Front-line System Event Tree was prepared as well to provide core-melt sequence delineation for accident progression analysis of Level 2 PSA which will be followed in a future. Applying U.S. operational experience data such as component failure rates and a LOSP frequency, we obtained the following results; - The total frequency of core-melt accident sequences initiated by LOSP is estimated at 5×10^{-4} per reactor-year. - The dominant sequences are 'Loss of Decay Heat Removal' and 'Loss of Emergency Electric Power Supply', which account for more than 90% of the total core-melt frequency. In this analysis, a higher value of 0.13/Rcenter dotY was used for the LOSP frequency than experiences in Japan and any recovery action was not considered. In fact, however, there has been no experience of LOSP event in Japanese nuclear power plants so far and it is also expected that offsite power and/or PCS would be recovered before core melt. Considering Japanese operating experience and recovery factors will reduce the total core-melt frequency to less than 10^{-6} per reactor-year. (J.P.N.).

42096 (Juel-Conf–69, pp. 230-236) **BATAN's activities in nuclear safety.** Suharno, I. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct 1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

A goal of BATAN's long-term programme on utilizing nuclear energy for electricity in Indonesia is to introduce nuclear power plant, where the safety aspect is the main consideration besides economical and political aspects. Presently BATAN has started to initiate some activities for studying nuclear power plant in some aspects including safety aspects for facing and handling plant which has high reliability and high safety in its operation. That goal achievement should be supported by improving and developing of technology, personnel capability and regulation through research activities. (orig./DG).

42097 (Juel-Conf–69, pp. 237-265) **Nuclear safety research in the Federal Republic of Germany - contribution to licensing process and plant performance.** Kollath, K. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct 1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

An overview is given on the current programme of reactor safety research in the Federal Republic of Germany. For a number of selected topics the development of the research work and the contribution of the results to licensing and plant performance is shown. The presentation concentrates on the research into component safety, quality assurance, transient analysis, accident sequences, man/machine interaction, risk, and reliability sponsored by the Ministry for Research and Technology. (DG).

42098 (Juel-Conf–69, pp. 266-280) **Ergonomics in nuclear and human factors engineering.** Muench, E. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Technik und Gesellschaft); Schultheiss, G.F. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct 1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

The work situation including man-machine-relationships in nuclear power plants is described. The overview gives only a compact summary of some important ergonomic parameters, i.e. human body dimension, human load, human characteristics and human knowledge. (DG).

42099 (Juel-Conf–69, pp. 281-301) **Role of standards and codes in enhancing nuclear safety.** Philip, G. (Kerntechnischer Ausschuss (KTA), Koeln (Germany, F.R.)); Schwarzer, W. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct 1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

The optimization of safety is a practically neverending process, especially in the area of nuclear technology. Standards and codes cannot afford to be stationary. It is essential that advances in science and technology and the invaluable experience gained from the construction, operation and decommissioning of nuclear facilities be an input into verifying whether existing standards need to be modified or updated. This was one of the important topics of discussion at a recent IAEA symposium on NUSS standards. The KTA standards program has a built-in feature to review standards periodically in this context. (orig./DG).

42100 (Juel-Conf–69, pp. 332-365) **Probabilistic risk analysis for nuclear power plants.** Hauptmanns, U. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct 1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

Risk analysis is applied if the calculation of risk from observed failures is not possible, because events contributing substantially to risk are too seldom, as in the case of nuclear reactors. The process of analysis provides a number of benefits. Some of them are listed.

After this by no means complete enumeration of possible benefits to be derived from a risk analysis. An outline of risk studiesd for PWR's with some comments on the models used are given. The presentation is indebted to the detailed treatment of the subject given in the PRA Procedures Guide. Thereafter some results of the German Risk Study, Phase B, which is under way are communicated. The paper concludes with some remarks on probabilistic considerations in licensing procedures. (orig./DG).

42101 (Juel-Conf–69, pp. 367-399) **Major reactor accidents and consequences.** Wolters, J. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct 1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

Accidents with core damage and release of radioactive material into the environment have been considered as major reactor accidents irrespective of the actual environmental consequences. Some of these accidents happened in sodium-cooled (fast) reactors but they have not been included here since the report was confined to thermal reactors. In selecting major reactor accidents in thermal reactors (NRX, Windscale I, SL-1, Lucens, TMI-2 and Chernobyl-4) no difference was made regarding the purpose of the respective reactor. In other words, military thermal reactors have also been taken into account. (orig./DG).

42102 (Juel-Conf–69, pp. 400-427) **Emergency planning and preparedness for nuclear facilities.** Koelzer, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct 1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

Nuclear installations are designed, constructed and operated in such a way that the probability for an incident or accident is very low and the probability for a severe accident with catastrophic consequences is extremely small. These accidents represent the residual risk of the nuclear installation, and this residual risk can be decreased on one hand by a better design, construction and operation and on the other hand by planning and taking emergency measures inside the facility and in the environment of the facility. By way of introduction and definition it may be indicated to define some terms pertaining to the subject in order to make for more uniform understanding. (orig./DG).

42103 (NIRS-M–69) **Environmental and health consequences in Japan due to the accident at Chernobyl nuclear reactor plant.** Uchiyama, Masafumi; Nakamura, Yuji; Kankura, Takako; Iwasaki, Tamiko; Fujimoto, Kenzo; Kobayashi, Sadayoshi. National Inst. of Radiological Sciences, Chiba (Japan). Mar 1988. 234p. Order Number DE89906457/JAW. Available from NTIS (US Sales Only), PC A11/MF A01.

A comprehensive review was made on the results of national monitoring program for environmental radioactivity in Japan resulting from the accident at the Chernobyl nuclear power plant in USSR. Period of monitoring efforts covered by the present review is from 30th of April 1986 to 31st of May 1987. A radioactive cloud released from the Chernobyl nuclear reactor initially arrived in Japan on 30th of April 1986 as indicated by the elevated level of ^{131}I, ^{137}Cs and ^{134}Cs activity in the total deposition on 30th of April and also by the increased ^{137}Cs body burden noted on 1st of May. Almost all the radioactive nuclides detected in the European countries were also identified in Japan. For example, the observed nuclides were: ^{95}Zr, ^{95}Nb, ^{99m}Tc, ^{103}Ru, ^{106}Ru, ^{110m}Ag, ^{111}Ag, ^{125}Sb, ^{127}Sb, ^{129m}Te, ^{131}I, ^{132}Te, ^{132}I, ^{133}I, ^{134}Cs, ^{136}Cs, ^{137}Cs, ^{140}Ba, ^{140}La, ^{141}Ce and ^{144}Ce. Among the above radionuclides, the country average concentration was determined for ^{131}I, ^{137}Cs and ^{134}Cs in various environmental materials such as air, fresh water, soil, milk, leafy and root vegetables, cereals, marine products and other foodstuffs. In contrast to the sharp decline of ^{131}I which was negligible after a few months, ^{137}Cs showed a tendency to maintain its activity in foodstuffs at an appreciable level one year later. Collective effective dose equivalent and dose equivalent to thyroid in Japanese population due to ^{137}Cs, ^{134}Cs and ^{131}I were estimated to be around 590 man Sv and 4760 man Sv, respectively. Corresponding values for the per caput dose equivalent are 5 μSv for whole body and 40 μSv for thyroid, respectively. (author).

42104 (NUREG/CP–0097-Vol.4, pp. 1-18) **Quantifying reactor safety margins. Part 1. An overview of the code scaling, applicability, and uncertainty evaluation methodology.** Boyack, B.E. (EG and G Idaho, Inc., Idaho Falls (USA)); Duffey, R.B.; Griffith, P.; Katsma, K.R.; Lellouche, G.S.; Levy, S.; Rohatgi, U.S.; Wilson, G.E.; Wulff, W.; Zuber, N. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

In August 1988, the Nuclear Regulatory Commission (NRC) approved the final version of a revised rule on the acceptance of emergency core cooling systems (ECCS) entitled Emergency Core Cooling System: Revisions to Acceptance Criteria. The revised rule states an alternate ECCS performance analysis, based on best-estimate methods, may be used to provide more realistic estimates of plant safety margins, provided the licensee quantifies the uncertainty of the estimates and includes that uncertainty when comparing the calculated results with prescribed acceptance limits. To support the revised ECCS rule, the NRC and its contractors and consultants have developed and demonstrated a method called the Code Scaling, Applicability, and Uncertainty (CSAU) evaluation methodology. It is an auditable, traceable, and practical method for combining quantitative analyses and expert opinions to arrive at computed values of uncertainty. This paper provides an overview of the CSAU evaluation methodology and its application to a postulated cold-leg, large-break loss-of-coolant accident in a Westinghouse four-loop pressurized water reactor with 17 x 17 fuel. The code selected for this demonstration of the CSAU methodology was TRAC-PF1/MOD1, Version 14.3.

42105 (NUREG/CP–0097-Vol.4, pp. 45-100) **Quantifying reactor safety margins: Application of CSAU methodology to LBLOCA.** Wulff, W.; Boyack, B.E.; Duffey, R.B.; Griffith, P.; Katsma, K.R.; Lellouche, G.S.; Levy, S.; Rohatgi, U.S.; Wilson, G.E.; Zuber, N. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

Comparisons of results from TRAC-PF1/MOD1 code calculations with measurements from Separate Effects Tests, and published experimental data for modeling parameters have been used to determine the uncertainty ranges of code input and modeling parameters which dominate the uncertainty in predicting the Peak Clad Temperature for a postulated Large Break Loss of Coolant Accident (LBLOCA) in a four-loop Westinghouse Pressurized Water Reactor. The uncertainty ranges are used for a detailed statistical analysis to calculate the probability distribution function for the TRAC code-predicted Peak Clad Temperature, as is described in an attendant paper (Part 4 of the presentation). Measurements from Separate Effects Tests and Integral Effects Tests have been compared with results from corresponding TRAC-PF1/MOD1 code calculations to determine globally the total uncertainty in predicting the Peak Clad Temperature for LBLOCAs. This determination is in support of the detailed statistical analysis mentioned above. The analyses presented here account for uncertainties in input parameters, in modeling and scaling, in computing and in measurements. The analyses are an important part of the work needed to implement the Code Scalability, Applicability and Uncertainty (CSAU)

methodology. CSAU is needed to determine the suitability of a computer code for reactor safety analyses and the uncertainty in computer predictions. The results presented here are used to estimate the safety margin of a particular nuclear reactor power plant for a postulated accident. Specifically, this paper describes, first in principle and then through their application, Steps No. 7 through 10 of the fourteen-step CSAU methodology.

42106 (NUREG/CP–0097-Vol.4, pp. 101-160) **Quantifying reactor safety margins. Part 4. Uncertainty evaluation of LBLOCA analysis based on TRAC-PF1/MOD 1.** Lellouche, G.S. (S. Levy Inc., Campbell, CA (USA)); Levy, S. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. DOE Contract AC07-76ID01570. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

The NRC has issued a revised Emergency Core Cooling System (ECCS) rule allowing the use of best estimate computer codes for safety analysis. The rule also requires an estimation of the uncertainty in the calculated system response and a comparison of the resulting bound with the acceptance limits of 10CFR Part 50. To support this revised rule the NRC and its consultants and contractors have developed and demonstrated the Code Scaling, Applicability and Uncertainty Methodology (CSAU). The last of the three elements of the methodology - Uncertainty Evaluation - is described in this paper.

42107 (NUREG/CP–0097-Vol.4, pp. 161-172) **Summary of ICAP assessment results for RELAP5/MOD2.** Driskell, W.E. (EG and G Idaho, Inc., Idaho Falls (USA)); Hanson, R.G. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

The International Code Assessment and Applications Program (ICAP) encompasses bilateral agreements between the US Nuclear Regulatory Commission and fourteen nations and/or multinational organizations. One purpose of the ICAP is to provide assessments of the RELAP5 computer code with the intent to identifying code deficiencies and drafting user guidelines. To date, twenty assessment studies have been provided by ICAP assessing the RELAP5/MOD2 code. Of these, ten have been reviewed and evaluated. Based on these ten studies, three code deficiencies were identified and four user guidelines drafted. The code deficiencies are listed and the user guidelines stated. A summary of the information considered and the procedure used in the identification of the code deficiencies and the formulation of user guidelines is given.

42108 (NUREG/CP–0097-Vol.4, pp. 173-178) **RELAP5/MOD3 development plan and status.** Weaver, W.L. III (EG and G Idaho, Inc., Idaho Falls (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. DOE Contract AC07-76ID01570. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

RELAP5/MOD3 is a pressurized water reactor (PWR) system analysis code being developed jointly by the US Nuclear Regulatory Commission (USNRC) and a consortium consisting of several of the countries that are members of the International Code Assessment Program (ICAP). The objective of the RELAP5/MOD3 code development program is to develop a code suitable for the analysis of all transients and postulated accidents in PWR systems including both large and small break loss of coolant accidents (LOCA's) as well as the full range of operational transients.

42109 (NUREG/CP–0097-Vol.4, pp. 179-198) **TRAC-PF1/MOD2 status and plans.** Spore, J.W.; Steinke, R.G.; Nelson, R.A.; Cappiello, M.W.; Jenks, R. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

The development of the TRAC-PF1/MOD1 code was completed in July 1988 with the release of Version 14.4. A TRAC-PF1/MOD2 code development plan addresses code deficiencies identified in the MOD1 code in order to provide an accurate and defensible tool that can be used to simulate large-break loss-of-coolant accidents (LOCAs), small-break LOCAs, and operational transients. The MOD2 code development plan is an international cooperative effort that includes contributions from Los Alamos National Laboratory, Idaho National Engineering Laboratory (INEL), Japanese Atomic Energy Research Institute (JAERI), Cray Research, Central Electricity Generating Board (CEGB), and United Kingdom Atomic Energy Authority (UKAEA).

42110 (NUREG/CP–0097-Vol.4, pp. 199-218) **Status of ICAP activities in Japan.** Murao, Y. (Japan Atomic Energy Research Institute, Ibaraki). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

In Fy 1988, International Code Assessment and Applications Program (ICAP) activities in Japan were started as a cooperative work between JAERI and Japanese industries. Based on the ICAP agreement, forty two assessment calculations are to be performed in Japan by Fy 1991. In Fy 1988, assessment matrix was determined and code installation of USNRC codes was started and almost completed. Eleven assessment calculations were performed with the TRAC-PF1 code. Status of these ICAP activities in Japan will be summarized in this paper.

42111 (NUREG/CP–0097-Vol.4, pp. 219-244) **JRC ISPRA contribution to the improvement of RELAP5/MOD2.** Staedtke, H. (Commission of the European Communities, Ispra (Italy)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

The assessment of the RELAP5/MOD2 code within the framework of the International Code Assessment and Application Program has identified various modelling deficiencies and a strong need for a further development of this code. For this reason, a multinational effort, coordinated by the ICAP Technical Program Group, has been started for the improvement of RELAP5/MOD2. The JRC-Ispra contribution to this activity is based on the experience gained from the improvement of RELAP5/MOD1. The paper summarizes several modifications and model improvements which have been implemented into a JRC Ispra version of RELAP5/MOD2. This concerns the calculations of state properties for vapor and steam, interphase drag coefficients, occurrence of stratified conditions in horizontal pipes and critical flows for saturated (two-phase) conditions. The results of these model improvements are demonstrated by the comparison of calculated values using the original and the modified version of RELAP5/MOD2 with separate effect and integral test data.

42112 (NUREG/CP–0097-Vol.4, pp. 245-273) **Switzerland's code assessment activities in support of the International Code Assessment Program (ICAP).** Aksan, S.N. (Paul Scherrer Institute,

Wuerenlingen (Switzerland)); Analytis, G.T.; Luebbesmeyer, D. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

Within the framework of the International Code Assessment Program (ICAP) of the US.NRC, independent code assessment analyses at Paul Scherrer Institute (PSI) have been performed using the RELAP5/MOD2 and TRAC-BD1/Mod1 thermal-hydraulic transient codes as part of the agreement. The assessment cases selected include both separate effects and integral tests. The calculations and analysis of most of the agreed assessment cases have been completed. In this paper, the main results and conclusions of these calculations are presented. As a result of these calculations and analysis, a number of special models which need to be further improved are identified and model changes are proposed. Some of these proposals are tested in an experimental version of RELAP5/Mod2 at PSI. In this assessment work, the rapid cladding cooling and quench during the blowdown phase of a large break loss-of-coolant has also been investigated in some detail. The experimental evidence available from blowdown quench, such as that encountered in the LOFT experiments, is reviewed. Calculations using the RELAP5/Mod2 code have been performed for the OECD/LOFT LP-LB-1 and LP-02-6 tests in order to identify the ability of the code to calculate the blowdown phase quench. To further investigate rapid cladding quenches, separate effects tests conducted in the LOFT Test Support Facility (LTSF) have also been calculated using the frozen version of RELAP5/Mod2. The preliminary results of these calculations and resulting findings are also presented in this paper.

42113 (NUREG/CP–0097-Vol.4, pp. 275-297) **TRAC and RELAP5 code development within the UK.** Brittain, I. (United Kingdom Atomic Energy Authority, Winfrith (England)); Coney, M. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

The UK is using the TRAC PF1 code for the assessment of licensing calculations for large break loss-of-coolant accidents (LOCA) in PWRs. The RELAP5 code is being used for small LOCAs and pressurized transients. The UK has participated in the International Code Assessment and Applications Program (ICAP) with respect to the assessment of TRAC PF1/MOD1 and RELAP5/MOD2 and some work is still on-going in this area. Since January 1988, the UK has also been collaborating with other ICAP members on the Code Improvement Plan, which seeks to remedy some of the code deficiencies identified in the assessment work. The contribution to the Code Improvement Plan is in three areas. The largest effort is directed at the problem of post-CHF (critical heat flux) heat transfer and quenching. Although it is hoped that the proposed improvements will be adopted for both codes, the UK effort is aimed at implementation in the TRAC code, since this is seen mainly as a large LOCA phenomenon. The second area of UK involvement is that of interphase drag under wet wall conditions. The main purpose of this work is to obtain improved predictions of voidage and level swell in rod bundles, particularly during small break LOCA. The UK implementation is therefore aimed at RELAP5 for this case. The third area is the implementation of an improved off-take model in order to make better predictions of the flow and quality from a junction or break in a horizontal pipe, such as the PWR hot leg, where stratified conditions might exist. The paper describes the work in progress in the UK relating to these three areas.

42114 (NUREG/CP–0097-Vol.4, pp. 313-330) **UMCP 2 x 4 loop observations regarding the behavior of an integral system during SB-LOCA.** Almenas, K. (Univ. of Maryland, College Park (USA)); Hsu, Y.Y.; diMarzo, M.; Pertmer, G.; Wang, Z. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

The test program at the University of Maryland, College Park (UMCP) 2×4 facility has conducted several series of small break-loss of coolant accidents (SB-LOCA) experiments. The accumulated data base is now sufficiently extensive that it is feasible to advance from the description of specific SB-LOCA transients to more generalized observations. The generality of the observations can be confirmed by comparison with the extensive data base generated by the once through integral system (OTIS) and multiloop integral system test (MIST) programs and selected test results provided by experiments at the SRI integral facility. A necessary initial step in the generalization of the extensive combined data base is a classification of the possible transient types and the identification of the observed flow modes. Several classification schemes have been employed. One divides the transient characteristics into the inherent response of the integral system itself and the modification of this response imposed by boundary conditions. Another scheme utilizes the observation that SB-LOCA transients can be divided into two dynamically different operational modes. These are quasi-steady state modes, and transition modes. The later can occur between two sequential quasi-steady state modes, but can also occur repeatedly for operational states which exhibit a cyclical character. It has been shown that the most dependable parameter for correlating the operational characteristics is the inventory of the primary system. The cyclical and oscillatory operational modes deserve special consideration. The causes and characteristics of oscillations vary. Some are generic and are observed in all of the integral system test (IST) facilities, a few are facility specific and can be related to specific atypicalities.

42115 (NUREG/CP–0097-Vol.4, pp. 331-357) **TRAC PF1/MOD1 calculations and data comparisons for MIST feed and bleed and steam generator tube rupture experiments.** Siebe, D.A. (Los Alamos National Lab., NM (USA)); Boyack, B.E.; Steiner, J.L. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

Los Alamos National Laboratory is a participant in the Integral System Test (IST) program initiated in June 1983 for the purpose of providing integral system test data on specific issues/phenomena relevant to post-small-break loss-of-coolant accidents, loss of feedwater and other transients in Babcock and Wilcox (B and W) plant designs. The Multi-Loop Integral System Test (MIST) facility is the largest single component in the IST program. MIST is a 2 x 4 (two hot legs and steam generators (SGs), four cold legs and reactor coolant pumps) representation of lowered-loop reactor systems of the B and W design. It is a full-height, full-pressure facility with 1/817 power and volume scaling. Two other integral experimental facilities are included in the IST program: test loops at the University of Maryland, College Park, and at SRI International (SRI-2). The objective of the IST tests is to generate high-quality experimental data to be used for assessing thermal-hydraulic safety computer codes. Efforts are under way at Los Alamos to assess TRAC-PF1/MOD1 against data from each of the IST facilities. Calculations and data comparisons for TRAC-PF1/MOD1 assessment are presented for two transients run in the MIST facility. These are MIST Test 330302, a feed and bleed test with delayed high-pressure injection; and Test 3404AA an SG tube-rupture test with the affected SG isolated. Only MIST assessment results are presented in this paper. The TRAC-PF1/MOD1 calculations completed to date for MIST tests are in reasonable agreement with the data from these tests.

42116 (NUREG/CP–0097-Vol.4, pp. 359-385) **Results and analysis of the INEL once through steam generator air-water and steam-water experiments.** Larson, T.K. (EG and G Idaho, Inc., Idaho Falls (USA)); Condie, K.G.; McCreery, G.E. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. DOE Contract AC07-76ID01570. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

Experiments have been conducted in steam/air-water facilities that model Babcock and Wilcox (B and W) Once Through Steam Generator heat transfer and fluid flow behavior during auxiliary feedwater (AFW) injection. The experiments and analysis described in this paper examine the basic phenomena of AFW radial and axial flow distribution, tube support plate (TSP) flooding, and tube heat transfer. Flow distribution is studied visually and measured in an unheated multi-tube (625 tubes) full scale 1/8 sector of the OTSG that includes three TSPs. Heat transfer is examined in a heated single tube facility with either one or two broached hole support plates and either air or steam upflow. The flow distribution experiments indicate that radial, axial, and azimuthal spreading is a strong function of AFW flow rate and a weaker function of vapor upflow although liquid spreading becomes an increasly stronger function of vapor upflow as the flooding line is approached. A semi-empirical model of AFW penetration without gas flow is presented. The model is extended to include the influence of gas flow by correlation. The heat transfer experiments indicate that heat transfer is highly dependent on AFW injection rate, and in particular on whether or not the water flows down the tubes as a continuous film or breaks into rivulets. A computer model of heat transfer has been developed, and is described. The data gathered during the experiments and the models developed from this data are currently being incorporated into the RELAP5 computer code.

42117 (NUREG/CP–0097-Vol.4, pp. 387-411) **Two-phase flow characteristic of inverted bubbly, slug, and annular flow in post-critical heat flux region.** Ishii, M. (Purdue Univ., West Lafayette, IN (USA)); Denten, J.P. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

Inverted annular flow can be visualized as a liquid jet-like core surrounded by a vapor annulus. While many analytical and experimental studies of heat transfer in this regime have been performed, there is very little understanding of the basic hydrodynamics of the post-critical heat flux (CHF) flow field. However, a recent experimental study was done that was able to successfully investigate the effects of various steady-state inlet flow parameters on the post-CHF hydrodynamics of the film boiling of a single phase liquid jet. This study was carried out by means of a visual photographic analysis of an idealized single phase core inverted annular flow initial geometry (single phase liquid jet core surrounded by a coaxial annulus of gas). In order to extend this study, a subsequent flow visualization of an idealized two-phase core inverted annular flow geometry (two-phase central jet core, surrounded by a coaxial annulus of gas) was carried out. The objective of this second experimental study was to investigate the effect of steady-state inlet, pre-CHF two-phase jet core parameters on the hydrodynamics of the post-CHF flow field. In actual film boiling situations, two-phase flows with net positive qualities at the CHF point are encountered. Thus, the focus of the present experimental study was on the inverted bubbly, slug, and annular flow fields in the post dryout film boiling region. Observed post dryout hydrodynamic behavior is reported. A correlation for the axial extent of the transition flow pattern between inverted annular and dispersed droplet flow (the agitated regime) is developed. It is shown to depend strongly on inlet jet core parameters and jet void fraction at the dryout point.

42118 (NUREG/CP–0097-Vol.4, pp. 413-429) **Loop seal clearing and refilling during a PWR small-break LOCA: results of ROSA-IV LSTF experiments.** Tasaka, K. (Japan Atomic Energy Research Institute, Ibaraki); Kukita, Y.; Katayama, J.; Nakamura, H.; Koizumi, Y.; Asaka, H. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

During a cold-leg small-break loss-of-coolant accident in a pressurized water reactor, the core collapsed liquid level is depressed when liquid in the loop seals is cleared by vapor toward the broken cold leg. Loop seal clearing and associated core level depression may occur again if the loop seals are refilled by water after clearing. This paper discusses experimental results on loop seal clearing and refilling obtained from loss-of-coolant experiments at the ROSA-IV Large Scale Test Facility (LSTF).

42119 (NUREG/CP–0097-Vol.4, pp. 431-444) **PKL III investigation of PWR off-design conditions.** Mandl, R.M. (Siemens AG, Erlangen (West Germany)); Brand, B.; Umminger, K. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

A new program aimed at experimentally investigating off-design transients with and without loss of coolant was started in 1987. This paper presents the overall program objectives as well as test results obtained so far. Future plans are also discussed.

42120 (NUREG/CP–0097-Vol.4, pp. 445-462) **Boron mixing in the lower plenum of a BWR.** Theofanous, T.G. (Univ. of California, Santa Barbara (USA)); Shabana, E.A. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

Current anticipated transients without scram (ATWS) procedures are complicated because of uncertainties regarding the flow behavior of the liquid poison injected into the lower plenum for control. The concern is that due to strong buoyancy forces the natural circulation flow (less than 30% of rated) would be insufficient to entrain and convect the cold boric acid solution upward and into the core area. Also of concern is the fact that Froude-number scaling becomes problematic at small scales. The purpose of this work is to bypass such concerns by carrying out a set of experimental simulations at full scale. Such full-scale simulations are practical because of the high degree of compartmentalization of a BWR lower plenum by the control rod guides and the nearly longitudinal flow of coolant in the interstitial spaces. The experimental facility represents a lower plenum slice corresponding to 9 guide tubes in the neighborhood of the injection standpipe (also included at full scale). The structural material is acrylic, allowing full visualization. The base flow is created by recirculation from a 2000-gal.-capacity tank at velocities of up to the full natural circulation strength expected in the reactor. The injection flow consists of NaCl or $CaCl_2$ solutions. The facility is instrumented for mapping out the local/instantaneous concentration (conductivity probes) and velocity (fibre optic laser doppler anemometer) fields. In this paper quantitative mixing information for a 3-nozzle injection is presented. The injection nozzle is aimed at the interstitial space between two radial rows of control rods. Full simulations with a 7-nozzle injection and project completion are scheduled for next year.

42121 (NUREG/CP–0097-Vol.4, pp. 463-484) **Admitting cold water into steam filled pipes without water hammer due to steam bubble collapse.** Chou, Y. (Institute of Nuclear Energy Research (Taiwan)); Griffith, P. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

Water hammer due to steam bubble collapse when cold water is admitted to vertical upward flowing, vertical downward flowing, and nominally horizontal pipes has been studied both experimentally and analytically. The work in horizontal pipes included a study of the effect of a slight downward inclination, a slight upward inclination, and the length of the pipe on the initiation of water hammer. Stability maps showing the combinations of filling velocities and liquid subcooling that cause water hammer and those which don't for each flow geometry were obtained from experiments. Analytical models were developed to predict those stability boundaries in the stability maps. All these models were tested with experimental data. Based on the verified models, a step-by-step approach for each flow geometry is presented for plant engineers and designers to follow in avoiding water hammer induced by steam bubble collapse.

42122 (NUREG/CP–0097-Vol.4, pp. 485-509) **UPTF upper plenum injection (UPI) test results and application to PWR.** Russell, A. (MPR Associates, Inc., Washington, DC (USA)); Damerell, P.; Ahrens, G.; Weiss, P. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

The upper plenum test facility (UPTF) upper plenum injection (UPI) test provides data on upper plenum and loop phenomena related to loss of coolant accident (LOCA) reflood in a UPI plant. The UPTF is about 2.1 times larger than a pressurized water reactor with UPI. Data from Semiscale, Instrument Development Loop (IDL), Dartmouth, Cylindrical Core Test Facility (CCTF), Slab Core Test Facility (SCTF) and UPTF now cover UPI phenomena at a range of scale from 1/600 to 2.1 relative to a UPI plant. The UPTF test included subcooled emergency core coolant (ECC) injection into the upper plenum simultaneously with saturated steam/water flow from a simulated reactor core. There were three test phases, to parametrically study core steam flow and distribution. The UPTF results show major water delivery to the core in a very local region, rapid formation of an upper plenum pool, 100% condensation efficiency with 80% in the upper plenum and 20% in the core, and significant storage of carryover water in the hot legs. These phenomena show distinct trends with scale when compared to the results from scaled tests. Estimated UPI plant LOCA behavior is also determined from these comparisons. The inferred UPI plant behavior indicates that good core cooling is expected in the event of a large break LOCA.

42123 (NUREG/CP–0097-Vol.4, pp. 511-531) **Use of 2D/3D data to scale up liquid carryover/de-entrainment (steam binding) behavior to a PWR.** Rhee, G. (Nuclear Regulatory Commission, Washington, DC (USA)); Damerell, P.; Simons, J. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

The behavior of liquid water entrained out of the top of the core is important during a large break loss-of-coolant accident (LOCA) in a pressurized water reactor (PWR). The upper plenum, hot legs and steam generator inlet plena can de-entrain and accumulate water, which is generally beneficial because it reduces water carryover to the steam generator tubes. In the tubes, water vaporizes and contributes to steam binding. Full-scale upper plenum test facility (UPTF) tests provide information on the de-entrainment and carryover phenomena. The test results show the upper plenum and steam generator inlet plena act as delay volumes for water transport by storing water in frothy pools. The time delays are about 6 and 30 seconds, respectively. The hot legs store liquid water in a stratified flow regime, with the amount stored dependent on steam flow. The remaining water not stored in these volumes is carried over to the steam generator tube region. Based on the UPTF data, a rule-of-thumb for PWR liquid transport is determined. Application of this rule to a transient actually run in UPTF shows reasonable agreement with measured water carryover to the steam generator. The amount carried over is about one-half of the water exiting the core for this transient.

42124 (NUREG/CP–0097-Vol.4, pp. 533-542) **Use of 2D/3D data for peak cladding temperature uncertainty studies.** Boyack, B.E. (Los Alamos National Lab., NM (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

In August 1988, the Nuclear Regulatory Commission (NRC) approved the final version of a revised rule on the acceptance of emergency core cooling systems (ECCS). The revised rule allows ECCS analysis based on best-estimate methods provided uncertainties in the prediction of prescribed acceptance limits are quantified and reported. To support the revised rule, the NRC developed the Code Scaling, Applicability, and Uncertainty (CSAU) evaluation methodology. Data from the 2D/3D program have been used in a demonstration of the CSAU methodology in two ways. First, the data were used to identify and quantify biases that are related to the implementation of selected correlations and models in the thermal-hydraulic systems code TRAC-PF1/MOD1 as it is used to calculate the demonstration transient, a large-break loss-of-coolant accident. Second, the data were used in a supportive role to provide insight into the accuracy of code calculations and to confirm conclusions that are drawn regarding specific CSAU studies. Examples are provided illustrating each of these two uses of 2D/3D data.

42125 (NUREG/CP–0097-Vol.4, pp. 543-555) **UPTF experiment - Principal experimental results to be used for improved LB LOCA understanding.** Weiss, P.A. (Siemens AG, Erlangen (West Germany)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

A series of 21 tests has been performed at a upper plenum test facility - a 1:1 scale test facility - to investigate the thermohydraulic phenomena in PWR primary systems during blowdown, refill and reflood phases. Based on test results a typical PWR loss of coolant accident scenario applying combined hot and cold leg emergency core coolant injection for core cooling is developed. Special attention is given to transient two-phase flow phenomena in the cold legs, downcomer, the tie plate region, upper plenum and hot legs.

42126 (NUREG/CP–0097-Vol.4, pp. 557-581) **Recent results of analytical study on SCTF-III tests for reflood phenomena of PWR with combined-injection-type ECCS under cold-leg-large-break LOCA.** Iguchi, T. (Japan Atomic Energy Research Institute, Ibaraki); Adachi, H.; Sugimoto, J.; Iwamura, T.; Akimoto, H.; Okubo, T.; Ohnuki, A.; Abe, Y.; Kikuta, M.; Murao, Y. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989.

(CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

The reflooding behavior in a PWR with a combined injection type ECCS was studied based on test results with Slab Core Test Facility (SCTF). Important phenomena for core cooling were physically analyzed. They are flow circulation in pressure vessel, condensation in upper plenum, heat transfer from two-phase upflow region to water downflow region and heat transfer coefficient in two-phase upflow region. Based on these analyses, the clad temperature transient was successfully predicted. This supports the validity of the phenomenological understanding obtained in the present study.

42127 (NUREG/CP–0097-Vol.4, pp. 583-606) **Assessment of J-TRAC code with CCTF/SCTF test data.** Akimoto, J. (Japan Atomic Energy Research Institute, Ibaraki); Ohnuki, A.; Kikuta, M.; Abe, Y.; Murao, Y. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, Gaithersburg, MD (USA), 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

The J-TRAC code has been developed at Japan Atomic Energy Research Institute (JAERI) to develop a standard code for reactor safety assessment. The J-TRAC code uses the TAC-PF1/MOD1 code as the framework of the code and uses physical models at JAERI for refill and reflood phases of a PWR loss of coolant accident (LOCA) based on physical understanding of phenomena. This paper summarizes results of assessment calculations of the J-TRAC code with cylindrical core test facility/slab core test facility test data. The assessment study confirms that the J-TRAC code can predict well core thermal hydraulic behaviors during reflood phase of a PWR LOCA including core void fraction profile and clad surface temperature. Several areas will be proposed for future improvements for exact prediction of clad temperature with 3D model and for stable system calculation.

42128 (NUREG/CR–2331-Vol.8-No.4) **Safety research programs sponsored by Office of Nuclear Regulatory Research: Progress report, October 1–December 31, 1988.** Weiss, A.J.; Azarm, A.; Baum, J.W.; Boccio, J.L.; Carew, J.; Diamond, D.J.; Fitzpatrick, R.; Ginsberg, T.; Greene, G.A.; Guppy, J.G.; Haber, S.B. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Jul 1989. 161p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (BNL-NUREG–51454-Vol.8-No.4). Available from NTIS, PC A08/MF A01 - GPO - OSTI.

This progress report describes current activities and technical progress in the programs at Brookhaven National Laboratory sponsored by the Division of Regulatory Applications, Division of Engineering, Division of Safety Issue Resolution, and Division of Systems Research of the US Nuclear Regulatory Commission, Office of Nuclear Regulatory Research following the reorganization in July 1988. The previous reports have covered the period October 1, 1976 through September 30, 1988.

42129 (NUREG/IA–0014) **Analysis of the THETIS boildown experiments using RELAP5/MOD2.** Croxford, M.G.; Hall, P.C. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Central Electricity Generating Board, Barnwood (UK). Jul 1989. 51p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A04/MF A01 - GPO - OSTI.

To test the ability of RELAP5/MOD2 to model two phase mixture level and fuel rod heat transfer when the core has become partially uncovered, post test calculations have been carried out of a series of boildown tests in the AEEW THETIS out-of-pile test facility. This report describes the comparison between the code calculations and the test data. Excellent agreement is obtained with mixture level boildown rates in tests at pressures of 40 bar and 20 bar. However at pressures below 10 bars the boildown rate is considerably overpredicted. A general tendency for RELAP5/MOD2 to overpredict void fraction below the two-phase mixture level is observed, which is traced to defects in the interphase drag models within the code. The heat up of exposed rods above the two-phase mixture level is satisfactorily calculated by the code. The results support the use of RELAP5/MOD2 for analysis of high pressure core boildown events in PWRs. 8 refs., 34 figs., 1 tab.

42130 (PNL–6500-Pt.4, pp. 5-10) **Chernobyl data base.** Carr, R. Jr.; Littlefield, J.S.; Robertson, D.E.; Davis, W.E.; Palmer, E.H.; McKinnon, A.D.; Mehlenbacher, L.L.; McClelland, J.M. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

Most of the work performed this past year has involved designing a relational data base structure to manage the data and obtaining data to load into the structure. Additional work has been performed in standardizing emergency response data and responding to requests for data from other organizations.

42131 (SAND–89-1692C) **Application of the IFCI [Integrated Fuel-Coolant Interaction] code to a FITS-type pouring mode experiment.** Young, M.F. Sandia National Labs., Albuquerque, NM (USA). 1989. 24p. Sponsored by DOD;NRC. DOE Contract AC04-76DP00789. (CONF-890739–2: 12. international colloquium on the dynamics of explosions and reactive systems, Ann Arbor, MI (USA), 23-28 Jul 1989). Order Number DE89015392/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The phenomenon of molten fuel-coolant interaction (FCI) is of considerable interest in many industrial processes where hot molten material may come in contact with water, including the pulp and paper, aluminum, steel, and nuclear power industries. The nature of the FCIs can range from mild film boiling, through energetic boiling, up to a violent vapor explosion. In the nuclear power industry, FCIs are of interest because of their possible consequences during hypothetical light water reactor core meltdown accidents. These interactions may occur under a variety of conditions either within the reactor vessel or in the reactor cavity. The IFCI computer code is being developed to investigate the FCI problem at large scale using a two-dimensional, four-field hydrodynamic framework and physically based models. IFCI will be capable of treating all major FCI processes in an integrated manner. The hydrodynamic method and physical models used in IFCI are discussed. Results from a test problem simulating a generic pouring mode experiment are presented. 39 refs., 10 figs., 1 tab.

42132 (WHC-EP–0240) **NUSAR: N reactor updated safety analysis report–Amendment 19.** Jack, M.L. Isuzu Motors Ltd., Southfield, MI (USA). Jul 1989. 400p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE89016667/JAW. Available from NTIS, PC A18 - OSTI.

This document comprises Amendment 19 of the N-Reactor Updated Safety Analysis Report (NUSAR). NUSAR, formerly UNI-M-90, was revised by 18 amendments that were issued by UNC Nuclear Industries, the contractor responsible for N-Reactor operations. As of June 1987, Westinghouse Hanford Company (Westinghouse Hanford) acquired the Operations and Engineering contract for N-Reactor and other facilities at Hanford. The document number for NUSAR then became WHC-SP-0297. The first revision issued by Westinghouse Hanford was Amendment 19, prepared originally by UNC. Summaries of each of the amendments are included in NUSAR Section 1.1. Amendment 19 was issued in June 1988 as an amendment with an Initial Release and Change Control Record (IRACCR) form, as explained in the standard engineering practices. From the time frame June 1989 forward under Westinghouse Hanford, Amendments to NUSAR will be issued as external publications. The Manual Revision Instruction (MRI) Form starts the amendment pages for each of the seven volumes. The MRI summarizes the pages of Amendment 19 that are to be replaced or added by the manual holders to revise each NUSAR volume.

42133 **Effectively processing and displaying alarm information.** Corsberg, D. (9502158). vp. of Proceedings of the 1988 IEEE fourth conference on human factors and power plants. Hagen, E.W.

IEEE Service Center, Piscataway, NJ (1988). (CONF-880633–: 4. international conference on human factors and power plants, Monterey, CA (USA), 5-8 Jun 1988).

The problems inherent to current alarm displays in power plants are well documented. Unfortunately, practical solutions have been slow in coming. This paper discusses issues involved in the installation of CRT-based alarm display at a nuclear power plant and a chemical processing facility. This alarm display is closely coupled with a knowledge-based aid called the Alarm Filtering System (AFS). A comparison of process characteristics to alarm display problems is made. Barriers to the integration of advanced operator aids are described and addressed.

42134 User interface design in safety parameter display systems. Schultz, E.E. Jr. (9511304); Johnson, G.L. vp. of Proceedings of the 1988 IEEE fourth conference on human factors and power plants. Hagen, E.W. IEEE Service Center, Piscataway, NJ (1988). (CONF-880633–: 4. international conference on human factors and power plants, Monterey, CA (USA), 5-8 Jun 1988).

The extensive installation of computerized safety Parameter Display Systems (SPDSs) in nuclear power plants since the Three-Mile Island accident has enhanced plant safety. It has also raised new issues of how best to ensure an effective interface between human operators and the plant via computer systems. New developments in interface technologies since the current generation of SPDSs was installed can contribute to improving display interfaces. These technologies include new input devices, three-dimensional displays, delay indicators, and auditory displays. Examples of how they might be applied to improve current SPDSs are given. These examples illustrate how the new use interface technology could be applied to future nuclear plant displays.

42135 A risk methodology to evaluate sensitivity of plant risk to human errors. Samanta, P. (Engineering Technology Div., Brookhaven National Lab., Upton, NY (US)); Wong, S.; Higgins, J.; Haber, S.; Luckas, W. vp. of Proceedings of the 1988 IEEE fourth conference on human factors and power plants. Hagen, E.W. IEEE Service Center, Piscataway, NJ (1988). (CONF-880633–: 4. international conference on human factors and power plants, Monterey, CA (USA), 5-8 Jun 1988).

This paper presents an evaluation of sensitivity of plant risk parameters, namely the core melt frequency and the accident sequence frequencies, to the human errors involved in various aspects of nuclear power plant operations. Results are provided using the Oconee-3 Probabilistic Risk Assessment model as an example application of the risk methodology described herein. Sensitivity analyses in probabilistic risk assessment (PRA) involve three areas: (1) a determination of the set of input parameters; in this case, various categories of human errors signifying aspects of plant operation, (2) the range over which the input parameters vary, and (3) an assessment of the sensitivity of the plant risk parameters to the input parameters which, in this case, consists of all postulated human errors, or categories of human errors. The methodology presents a categorization scheme where human errors are categorized in terms of types of activity, location, personnel involved, etc., to relate the significance of sensitivity of risk parameters to specific aspects of human performance in the nuclear plant.

42136 Foundations for a time reliability correlation system to quantify human reliability. Dougherty, E.M. Jr. (Science Applications International Corp., 708 S. Illinois Ave., E-101, Oak Ridge, TN (US)); Fragola, J.R. vp. of Proceedings of the 1988 IEEE fourth conference on human factors and power plants. Hagen, E.W. IEEE Service Center, Piscataway, NJ (1988). (CONF-880633–: 4. international conference on human factors and power plants, Monterey, CA (USA), 5-8 Jun 1988).

Time reliability correlations (TRCs) have been used in human reliability analysis (HRA) in conjunction with probabilistic risk assessment (PRA) to quantify post-initiator human failure events. The first TRCs were judgmental but recent data taken from simulators have provided evidence for development of a system of TRCs. This system has the equational form: $t = tau_R \times tau_U$, where the first factor is the lognormally distributed random variable of successful response time, derived from the simulator data, and the second factor is a unitary lognormal random variable to account for uncertainty in the model. The first random variable is further factored into a median response time and a factor to account for the dominant type of behavior assumed to be involved in the response and a second factor to account for other influences on the reliability of the response.

42137 USNRC's nuclear plant analyzer: Engineering simulation capabilities in the 1990's. Laats, E.T. (Idaho National Engineering Lab., Idaho Falls (USA)). pp. 368 of Nuclear simulation. Proceedings. Heller, M.R. (ed.) Springer, Berlin, Germany, F.R. (1987). DOE Contract AC07-76ID01570. (CONF-871068–: International nuclear simulation symposium and mathematical modeling workshop, 13-15 Oct 1987).

The Nuclear Plant Analyzer (NPA) is the U.S. Nuclear Regulatory Commission's (NRC's) state-of-the-art nuclear reactor simulation capability. This computer software package integrates high fidelity nuclear reactor simulation codes such as the TRAC and RELAP 5 series of codes with color graphics display techniques and advanced workstation hardware. The NPA first became operational at the Idaho National Engineering Laboratory (INEL) in 1983. Since then, the NPA system has been used for a number of key reactor safety-related tasks ranging from plant operator guidelines evaluation to emergency preparedness training. The NPA system is seen by the NRC as their vehicle to maintain modern, state-of-the-art simulation capabilities for use into the 1990s. System advancements are envisioned in two areas: first, software improvements to existing and evolving plant simulation codes utilized by the NPA through the use of such techniques as parallel and vector processing and artificial intelligence expert systems, and second, advanced hardware implementations using combinations of super-, minisuper-, supermini-, and supermicrocomputer systems and satellite data communications networks for high flexibility and greatly increased NPA system performance. (orig.).

42138 NUCLARR and human reliability. Gertman, D.I. (9502158); Gilmore, W.E.; Ryan, T.G. vp. of Proceedings of the 1988 IEEE fourth conference on human factors and power plants. Hagen, E.W. IEEE Service Center, Piscataway, NJ (1988). (CONF-880633–: 4. international conference on human factors and power plants, Monterey, CA (USA), 5-8 Jun 1988).

The Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR) is an automated data base management system used to process, store, and retrieve human and equipment reliability data. Human error rate data are stored and accessed according to the personnel, human actions and equipment included in the error. All examples of human error represented in this data base are quantitative in nature. Additional information is supplied regarding plant conditions, performanced shaping factors, and the data source. Probabilities and corresponding confidence bounds are presented to the analyst in an easy-to-use personal computer (PC) environment. The data base accepts probabilistic estimates culled from the most recent human reliability assessment (HRA) methods.

42139 Model development for the determination of the influence of management on plant risk. Haber, S.B. (Engineering Technology Div., Brookhaven National Lab., Upton, NY (US)); O'Brien, J.N.; Ryan, T.G. vp. of Proceedings of the 1988 IEEE fourth conference on human factors and power plants. Hagen, E.W. IEEE Service Center, Piscataway, NJ (1988). (CONF-880633–: 4. international conference on human factors and power plants, Monterey, CA (USA), 5-8 Jun 1988).

This paper outlines the development of an organization model which is used to determine the influence of supervisory and management functions in a nuclear power plant (NPP) on risk. A theoretical conceptualization, derived from the empirical literature, is used to describe the organizational structure of NPPs. The parameters and variables associated with this dynamic, process-oriented model are detailed. Applications of the model and preliminary insights derived from this conceptualization are discussed.

42140 Non-destructive testing in maintenance and the role of the human operator. Triggs, T.J. (Battelle Human Affairs Research Centers, 4000 N.E. 41st Street, Seattle, WA (US)). vp. of Proceedings of the 1988 IEEE fourth conference on human factors and power plants. Hagen, E.W. IEEE Service Center, Piscataway, NJ (1988). (CONF-880633–: 4. international conference on human factors and power plants, Monterey, CA (USA), 5-8 Jun 1988).

Non-destructive evaluation tests have assumed an important role in the maintenance of a range of complex systems, including nuclear power plants and aviation. A wide family of such testing methods have been developed over the years of which a number have achieved a high degree of technical sophistication. However, while most of the techniques rely to a considerable degree on the human operator in order to obtain good performance, human factors issues have received relatively little attention. Given the general need to assess the efficacy of maintenance systems, an analysis of data in relative operator characteristic terms is advocated. Some future research needs in this area of maintenance are identified.

42141 Root cause analysis at Savannah River Plant. Paradies, M. (Savannah River Plant, Building 105-C, Aiken, SC (US)); Busch, D. vp. of Proceedings of the 1988 IEEE fourth conference on human factors and power plants. Hagen, E.W. IEEE Service Center, Piscataway, NJ (1988). (CONF-880633–: 4. international conference on human factors and power plants, Monterey, CA (USA), 5-8 Jun 1988).

Events (or near misses) provide important information about ways to improve plant performance. Any particular event may have several root causes that need correcting to prevent recurrence of the event and, thereby, improve the safety of the plant. Also, by reviewing a large number of events, one can identify cause trends or generic concerns. A method has been developed at Savannah River Plant (SRP) to systematically evaluate events, identify their root causes, record the root causes, and analyze the root cause trends. By providing a systematic method to identify correctable root causes, the system helps the event investigator ask the right questions during the investigation. It also provides an independent safety analysis group and management with statistics indicating existing and developing trouble spots.

42142 Unexpected effects of computer presented procedures. Blackman, H.S. (9502158); Nelson, W.R. vp. of Proceedings of the 1988 IEEE fourth conference on human factors and power plants. Hagen, E.W. IEEE Service Center, Piscataway, NJ (1988). (CONF-880633–: 4. international conference on human factors and power plants, Monterey, CA (USA), 5-8 Jun 1988).

Results from experiments conducted at the Idaho National Engineering Laboratory have been presented regarding the computer presentation of procedural information. The results come from the experimental evaluation of an expert system which presented procedural instructions to be performed by a nuclear power plant operator. Lessons learned and implications from the study are discussed as well as design issues that should be considered to avoid some of the pitfalls in computer presented or selected procedures.

42143 A strategy for examining human reliability aspects of plant security. O'Brien, J.N. (Engineering Technology Div., Brookhaven National Lab., Upton, NY (US)); Luckas, W.J. Jr. vp. of Proceedings of the 1988 IEEE fourth conference on human factors and power plants. Hagen, E.W. IEEE Service Center, Piscataway, NJ (1988). (CONF-880633–: 4. international conference on human factors and power plants, Monterey, CA (USA), 5-8 Jun 1988).

This paper presents a strategy for developing a long-term research plan for human factors issues which can adversely affect safeguards at nuclear power plants. It was developed in order to prioritize and propose research for appropriately addressing nuclear power plant safeguards needs. The strategy consists of a series of parts, the first of which identifies and ranks human factors issues affecting the quality of nuclear power plant safeguards in terms of their importance. The second part involves determining the feasibility of conducting research in the areas found to be important to nuclear power plant safeguards. Third, research efforts are then developed and prioritized into main program elements according to the importance of human factors issue areas derived in the first part and the feasibility of research determined in the second part.

42144 The right data for the right decision. Chockie, A.D. (Battelle Human Affairs Research Centers, 4000 N.E. 41st Street, Seattle, WA (US)); Olson, J.L.; Thurber, J.A. vp. of Proceedings of the 1988 IEEE fourth conference on human factors and power plants. Hagen, E.W. IEEE Service Center, Piscataway, NJ (1988). (CONF-880633–: 4. international conference on human factors and power plants, Monterey, CA (USA), 5-8 Jun 1988).

This paper identifies and discusses a number of issues associated with the development and use of performance indicators for commercial nuclear power plants. The paper reviews the objectives of various users of performance indicators and addresses the problem of applying the right performance indicators to the needs of these users. The analysis concludes with a brief discussion of how the different user objectives of performance indicators can lead to conflicts over the definition and implementation of performance indicator systems.

42145 Human engineering considerations in designing a computerized controlled access security system. Moore, J.W. (9513035); Banks, W.W. vp. of Proceedings of the 1988 IEEE fourth conference on human factors and power plants. Hagen, E.W. IEEE Service Center, Piscataway, NJ (1988). (CONF-880633–: 4. international conference on human factors and power plants, Monterey, CA (USA), 5-8 Jun 1988).

This paper describes a human engineering effort in the design of a major security system upgrade at Lawrence Livermore National Laboratory. This upgrade was to be accomplished by replacing obsolete and difficult-to-man (i.e., multiple operator task actions required) security equipment and systems with a new, automated, computer-based access control system. The initial task was to assist the electronic and mechanical engineering staff in designing a computerized security access system too functionally and ergonomically accommodate 100% of the Laboratory user population. The new computerized access system was intended to control entry into sensitive exclusion areas by requiring personnel to use an entry booth-based system and/or a remote access control panel system. The primary user interface with the system was through a control panel containing a magnetic card reader, function buttons, LCD display, and push-button keypad.

42146 Probabilistic risk assessment based inspection guidance for Arkansas Nuclear One Unit 1. Vo, T.V. (9500022); Harris, M.S.; Gore, B.F. *Nuclear Technology (USA)*, 84(1): 14-22 (Jan 1989).

Probabilistic risk assessment (PRA) based inspection guidance has been developed using information from the PRA for Arkansas Nuclear One Unit 1 (ANO-1). An analytical method was developed for calculating risk importance for affected plant systems. This was used to prioritize the ANO-1 plant systems using the Fussel-Vesely importance measure on the basis of core melt probability. System fault trees were reanalyzed to identify and rank the risk significant components in each system. The product of this effort is a prioritized listing of systems and components associated with 98% of the inspectable portion of the risk from ANO-1.

42147 The performance of High-Temperature Reactor fuel particles at extreme temperatures. Nabielek, H. (3561000); Schenk, W.; Heit, W.; Mehner, A.W.; Goodin, D.T. *Nuclear Technology (USA)*, 84(1): 62-81 (Jan 1989).

Coated particles embedded in graphitic elements are the fuel for the High-Temperature Reactor (HTR). Experimental investigations of the performance of particles at extremely high temperatures have been conducted to achieve an understanding of coating failure mechanisms and to establish the data base for safety and risk analyses of hypothetical accidents in large- and medium-sized HTRs. The primary mechanism for coating failure and fission product release in the 1900 to 2500^{0}C temperature range is thermal decomposition of silicon carbide (SiC). Heating tests have provided the activation energy of this process and the correlation of SiC decomposition with coating failure and subsequent fission product release.

42148 Fission-fragment energy deposition in argon. Torczynski, J.R. (9511412); Gross, R.J.; Hays, G.N.; Harms, G.A.; Neal, D.R.; McArthur, D.A.; Alford, W.J. *Nuclear Science and Engineering (USA)*, 101(3): 280-284 (Mar 1989).

The gas-dynamic response of argon to fission-fragment energy deposition is simulated, for the first time explicitly including the coupling between the gas density, which is spatially and temporally varying, and the power density. In simulations of three experiments with different initial fill pressures of argon, good agreement was found between calculated and observed pressure rises, after the experimental pressure rise data from one case were used as a calibration. However, in each case, the calculated thermal energy

deposition corresponding to the experimental pressure data was about half the fission-fragment kinetic energy release into the gas predicted by neutron and fission-fragment transport calculations. Also, the experimental pressure data exhibited a decay not seen in the simulations, which did not incorporate an energy-loss mechanism.

42149 Overview of the Electric Power Research Institute research program on common-cause failures. Worledge, D.H. (9500767); Wall, I.B. *Nuclear Technology (USA),* 84(3): 256-259 (Mar 1989).

The Electric Power Research Institute research project on common cause failures (CCFS) is the main vehicle for presenting a survey of developments in the field over the last 5 yr. The roles of other organizations worldwide are highlighted to show the international and synergistic character of the work accomplished. Included are aspects of data analysis, modeling approaches, and defensive strategies and tactics that can lessen the impact of CCFs on risk and plant operations. The emphasis is on how the available approaches can be seen to contribute to a more systematic and integrated treatments of CCFs in applied risk and reliability analyses that has been available in the past. Opportunities for future research are also briefly discussed.

42150 Analysis of a PWR natural circulation transient at beginning of life. Mosteller, R.D.; Jensen, P.J.; Anderson, M.J.; Eisenhart, L.D.; Abdollahian, R.; Chao, J.; Eich, W.J. *Transactions of the American Nuclear Society (USA),* 57: 308-309 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

A pressurized water reactor (PWR) with a positive moderator temperature coefficient (MTC) of reactivity is potentially susceptible to a severe overheating transient, particularly if some of its scram setpoints have been disabled. This study identifies an actual scenario in which such a transient could occur and analyzes it to determine whether domestic PWRs are susceptible to a catastrophic power excursion, which might occur as the result of a scram failure. The MTC is of paramount importance in transients of this type. In fact, the behavior of the MTC is the primary factor in determining the severity of the transient. To determine the inherent safety of PWR cores with respect to such postulated transients, a PWR that constitutes the most susceptible reactor of this type has been analyzed. It contains low-enrichment fuel of an advanced design, partial length burnable poisons, and a high critical soluble boron concentration at beginning of life (BOL). The analysis of the transient employed portions of the Electric Power Research Institute's ARMP-02 physics package in conjunction with its advanced nodal code ARROTTA and a slightly modified version of its RETRAN-02 systems transient code. This study has demonstrated that US PWRs are not susceptible to catastrophic power excursions that might occur as the result of a scram failure during natural circulation tests.

42151 Validation of the HOTCHAN code for analyzing the EBR-II core following an unprotected loss of flow. Mohr, D. (Argonne National Lab., IL (USA)); Chang, L.K.; Planchon, H.P. *Transactions of the American Nuclear Society (USA),* 57: 318-319 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

A series of reactor experiments involving unprotected (no scram) loss-of-primary flow (LOF) down to natural convection was successfully conducted in February and April of 1986 on the Experimental Breeder Reactor II (EBR-II). The predicted and measured behavior of a special instrumented assembly, the XX09-fueled INSAT, was compared for the most severe test (SHRT 45) to demonstrate the validation of the thermal-hydraulic code HOTCHAN. The particular test of interest in this paper was initiated at full power by tripping the primary and secondary pumps. These tests were part of the shutdown heat removal tests (SHRT) being conducted in EBR-II. The reactor and balance of plant are extensively instrumented, and measurements were recorded by a data acquisition system. The reactor and plant response confirm predictions that the driver fuel cladding can survive temperatures above the eutectic threshold for the transient following a station blackout without scramming the reactor. In addition, the in-core data provide a firm basis for validation of the Argonne/EBR-II developed HOTCHAN code for analyzing the thermal-hydraulic behavior of specific fuel subassemblies. In this paper the analytical model for HOTCHAN is described as well as it relationship to the NATDEMO code. The predicted behavior of the hottest driver subassembly is also discussed and compared with the INSAT XX09 results.

42152 Flexible robotic entry device for a nuclear materials production reactor. Heckendorn, F.M. II. *Transactions of the American Nuclear Society (USA),* 57: 331-332 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

The Savannah River Laboratory has developed and is implementing a flexible robotic entry device (FRED) for the nuclear materials production reactors now operating at the Savannah River Plant (SRP). FRED is designed for rapid deployment into confinement areas of operating reactors to assess unknown conditions. A unique smart tether method has been incorporated into FRED for simultaneous bidirectional transmission of multiple video/audio/control/power signals over a single coaxial cable. This system makes it possible to use FRED under all operating and standby conditions, including those where radio/microwave transmissions are not possible or permitted, and increases the quantity of data available.

42153 Utilizing model-based control for safing of robotic manipulators. Petrosky, L.J. *Transactions of the American Nuclear Society (USA),* 57: 333 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

The feasibility of incorporating safety functions into a sophisticated model-based control (MBC) system has been demonstrated. It is being utilized as a basis for advanced safing (detection and safe response to abnormal conditions) for robotic manipulators without the use of special sensors. An MBC-based safing system provides for rapid detection of collisions and changes in payload and may be applied to the detection of numerous additional conditions. This work demonstrates through an experimental robotic system that real-time MBC is feasible and suitable for manipulator safing.

42154 Significance of steam separator models for BWR water level transients. Akiyama, T.; Shida, T.; Shibuya, A. *Transactions of the American Nuclear Society (USA),* 57: 346-347 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

The loss-of-power accident (LOPA) test is required in the series of startup tests for a new plant. In this test, the reactor water level goes down further than in other tests, but it stays a sufficient margin above the lower limit level. However, there is a tendency for simulation results to give an overly conservative water level response compared with test data. Such a situation requires greater standby pump capacity in the feedwater system. After reviewing several possible model improvements, it was noted that the performance of the steam separator has a significant effect on the reactor water level calculation for this event. To develop an improved model, the inverse problem approach (IPA) was applied. The IPA consists of three main procedures: (a) state estimation from the sensed signal, (b) forced simulation to replace the method variable with the estimated state, and (c) introducing hypothetical parameters and tracing them so that the difference between calculated and measured reactor water levels is minimized during the simulation. The simulation results are summarized.

42155 Application of best-estimate thermal-hydraulic methods for PWRs with UPI. Parker, T.; Kohrt, R.; Dederer, S.I.; Hochreiter, L.E.; Schwarz, W.R.; Tsai, C.K.; Young, M.Y. *Transactions of the American Nuclear Society (USA),* 57: 352-353 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

The emergency core cooling system (ECCS) for domestic Westinghouse designed two-loop pressurized water reactors (PWRs) provides low lead safety injection flow into the upper plenum region of the reactor vessel. This design is called the upper plenum injection (UPI) system. The high-pressure safety injection flow and the passive accumulator flow are injected into the cold legs similar to

that in Westinghouse-designed three- and four-loop PWRs. The paper discusses the realistic thermal-hydraulic computer code COBRA/TRAC, which Westinghouse has further developed from its initial released state and is now called WCOBRA/TRAC. The use of computer code calculations that have best-estimate thermal-hydraulic models has been encouraged by the NRC and is a key feature in the proposed Appendix K rule change. While current regulations remain in force, an interim approach given in NRC staff position paper SECY-83-472 permits the use of best-estimate thermal-hydraulic models. The paper presents realistic calculations which are examples of how best-estimate thermal-hydraulic methods are being used today.

42156 Coupling method of 1-d/1-d and 1-d/3-d junctions for an implict WCOBRA/TRAC. Takeuchi, K.; Young, M.Y. *Transactions of the American Nuclear Society (USA),* 57: 353-355 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

COBRA/TRAC is an advanced thermal-hydraulic computer code, originally developed by Battelle Pacific Northwest Laboratories. The code combines a two-fluid, three-dimensional (3-d) program, COBRA-TF, with a one-dimensional (1-d) drift flux program, TRAC-PD2. COBRA-TF is designed to be used to model the pressurized water reactor (PWR), and loop components are modeled with TRAC-PD2. An implicit method was proposed for the COBRA part of the code, and some success was achieved as demonstrated by an analysis of a film-boiling experiment for a steady-state and power ascension transient. On the other hand, TRAC-PD2 includes an option to choose a semi-implicit or an implicit method in solving component equations. This implicit option improves running time somewhat, but the junctions among the components are treated semi-implicitly. So, the time step is controlled by the Courant numbers at the 1-d/3-d and 1-d/1-d component junctions. In order to speed up the code further, the solution method for the junctions must be changed to implicit. An implicit method is introduced. It is evaluated by a COBRA/TRAC model of a less-of-fluid test (LOFT) and a two-loop PWR.

42157 Analyses of Mark I drywell shell melt-through. Weingardt, J.J.; Bergeron, K.D. *Transactions of the American Nuclear Society (USA),* 57: 356-357 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

In the vent of a core meltdown accident and subsequent release of molten core debris (corium) onto the drywell floor of a boiling water reactor (BWR) and a Mark I containment design, the issues of corium spreading and thermal attack on the steel drywell shell become extremely important. Numerous studies of the question have been undertaken. In the draft version of the US Nuclear Regulatory Commission's risk reference document, NUREG-1150, the drywell shell melt-through issue was identified as being one of the most important contributors to the uncertainty of risk in the Peach Bottom plant. Consequently, a study was initiated to address the transient conduction aspects of the thermal attack on the steel shell. A series of parametric calculations has been performed with the TAC2D computer code to elucidate uncertainties about the survivability of the BWR Mark I containment boundary in the event of a severe accident resulting in corium spreading to the drywell shell. Since TAC2D is a two-dimensional thermal analysis code utilizing static geometry, it is not possible to model all of the complexities of the corium spreading process or the debris/concrete interactions that are likely to occur. The two-dimensional transient nature of the shell thermal response is modeled better, however, with TAC2D than is possible with existing debris/concrete interaction codes.

42158 Boiling water reactor building environments after containment failure. Dingman, S.E.; Payne, A.C. Jr. *Transactions of the American Nuclear Society (USA),* 57: 357-359 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

In this paper, the results of calculations performed for the LaSalle Unit II Level 3 probabilistic risk analysis (PRA) under the Phenomenology and Risk Uncertainty Evaluation Program are discussed. For accident sequences at LaSalle in which containment heat removal has failed but core cooling is working, the primary containment would pressurize until it is either vented at 5.17 bar (60 psig) or fails at ≈ 14.5 bar (195 psig). In either case, severe steam environments would be created in the reactor building, posing a threat to the various safety and nonsafety systems used for core cooling. To evaluate the survivability of the equipment, a detailed reactor building model was constructed for use in the MELCOR code, and calculations were performed for various containment venting and failure scenarios. The results of these calculations were used to quantify the probability of equipment failure, using the results of the NUREG-1150 expert review group that evaluated the probability of equipment survival for various harsh environments.

42159 Low-pressure cutoff for melt dispersal from reactor cavities. Tutu, N.K. (Brookhaven National Lab., Upton, NY (USA)); Ginsberg, T.; Finfrock, C. *Transactions of the American Nuclear Society (USA),* 57: 359-360 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

Consider a potential core melt accident sequence during which the reactor pressure vessel fails while the primary system is still at high pressure. The molten core material, consisting of oxides and unreacted zirconium and stainless steel, is assumed driven from the reactor vessel under high primary system pressure into the region beneath the vessel (reactor cavity). Steam, which follows the melt discharge from the vessel, flows at high velocity through the reactor cavity region, finely fragments the molten core material into droplets, interacts thermally and chemically (thus producing hydrogen) with the melt, and carries some fraction of melt droplets into the containment subcompartments just above the cavity. Hydrogen produced in the reactor cavity and subcompartments will be transported to the dome where combustion with oxygen would occur if conditions permitted. The core debris, during its flight through the subcompartments and the containment dome, transfers some fraction of its thermal and chemical energy directly to the containment atmosphere. This phenomenon of direct energy exchange between the core melt and containment atmosphere, which leads to rapid containment pressurization, is termed direct containment heating (DCH). This paper describes the results of debris dispersal experiments that were performed to determine the maximum permissible primary system pressure at vessel failure (low-pressure cutoff for debris dispersal) that yields negligible dispersal of core melt from the Surry reactor cavity.

42160 Low-pressure debris dispersal from scaled reactor cavities. Nichols, R.T.; Tarbell, W.W. *Transactions of the American Nuclear Society (USA),* 57: 360-361 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

During a severe nuclear reactor accident, degradation of the core may result in debris accumulating in the lower head. Upon failure of the head, the melt may be ejected under pressure through the cavity and into the containment building. Under low system pressure conditions, understanding the mechanisms of debris dispersal is instrumental in assessing the response of the containment to pressurized melt ejection. Current analytical approaches rely on empirical correlations for debris entrainment criteria and very simple gas flow patterns in the cavity. The work reported here is directed toward performing scaled experiments that will develop a data base for refined scaling analyses. Subsequently, extrapolations from the analyses to reactor scale may be performed to provide insight for accident predictions. Mechanistic models for gas flow through the cavity and entrainment of the debris are also being developed from the results presented here. The objective of the test matrix is to vary key parameters to assess the effect on the physical processes of dispersal of the melt from the reactor cavity at low system pressures.

42161 Direct containment heating and aerosol generation during high-pressure-melt expulsion experiments. Tarbell, W.W.; Brockmann, J.E.; Washington, K.E.; Pilch, M.; Marx, K.D. *Transactions of the American Nuclear Society (USA),* 57: 361 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

Severe nuclear plant accidents can involve the degradation of the reactor core while the primary coolant system remains pressurized.

Molten fuel reaching the lower head of the reactor pressure vessel (RPV) may attack and fail the instrument guide tube penetrations, allowing the tube to be expelled from the vessel. The resulting aperture allows the molten fuel to be ejected into the cavity, followed by the blowdown of the contents of the primary system (high-pressure-melt ejection). Entrainment of the core debris in the cavity by the blowdown gases may cause high-temperature fuel particles to be carried into the containment building. Energy exchange between the particles and the atmosphere may cause heating and pressurizing of the containment [direct containment heating (DCH)]. The complex phenomena associated with direct containment heating accident sequences are not well understood. This work describes a series of four experiments that have been performed to study and quantify the processes involved. The data from the experiments are used to guide the development of computer models to describe the response of containments under accident conditions.

42162 Droplet structure interactions in direct containment heating. Baker, L. Jr.; Pilch, M.; Tarbell, W.W. *Transactions of the American Nuclear Society (USA),* 57: 361-363 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

Direct containment heating (DCH) in light water reactors can occur during severe accidents that involve the meltout of the bottom of the reactor vessel while the vessel is at high pressure. The ejected core debris can heat and pressurize the atmosphere and challenge the integrity of containment. The results of recent large-scale direct containment heating tests in the Surtsey facility at the Sandia National Laboratories have demonstrated the importance of the interactions of core debris with structure. In the DCH-2, -3, and -4 tests, > 50% of the simulated core debris injected into the large vessel was found frozen to the ceiling or sidewalls. This finding led to questions concerning the detailed physics of debris/structure interactions. It was expected that vigorous splashing assisted by gravity would have limited the quantity of frozen debris to much smaller amounts. Accordingly, a search of the technical literature was undertaken in the areas of liquid drop interactions with surfaces and with other liquid drops to provide the bases for modeling. The available information was reviewed for applicability to the DCH process. The results of the search and review led to a correlation for the splashing process and a preliminary explanation of the DCH test results in the form of illustrative models.

42163 Computer model for the transport and chemical reaction of debris in direct containment heating experiments. Marx, K.D. (Sandia National Lab., Albuquerque, NM (USA)). *Transactions of the American Nuclear Society (USA),* 57: 363-364 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

The transport and chemical reaction of debris is a problem of current interest in the study of certain nuclear reactor accident scenarios. In some situations, debris from the core of a reactor could be expelled into the atmosphere inside a reactor containment building. The debris would then heat the gas, resulting in an increase in the pressure in the containment. Furthermore, the exothermic reaction of the debris with the oxygen in the air would cause additional heating of the atmosphere. The present work is part of a study being carried out to determine whether this heating will be sufficient to place the integrity of the containment building at risk due to overpressurization. The authors have developed methods for computer simulation of some of the physical processes involved in such direct containment heating (DCH) configurations. In this paper, these numerical algorithms are used to model experiments pertinent to the reactor debris dispersal problem. The resulting computer code, referred to as Kiva-DCH, has been applied to the simulation of experiments performed in the Surtsey facility at Sandia National Laboratories in Albuquerque, New Mexico. It is found that the computational results agree well with those obtained from an experiment conducted at modest debris mass.

42164 CONTAIN calculations of direct containment heating in the Surry plant. Williams, D.C. (Sandia National Lab., Albuquerque, NM (USA)); Louie, D.L.Y. *Transactions of the American Nuclear Society (USA),* 57: 364-365 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

The draft NUREG-1150 risk analysis performed for the Surry plant identified direct containment heating (DCH) as a potentially dominant contributor to the total public risk associated with this plant. At that time, however, detailed mechanistic calculations of DCH loads were unavailable. Subsequently, a series of analyses of DCH scenarios using the CONTAIN-DCH code was performed in order to put the treatment of DCH on a firmer basis in the final draft of NUREG-1150. The present paper describes some of the results obtained for the Surry plant.

42165 Simulation of the semiscale MOD-2C SBLOCA using MAAP-DOE. Vanover, D.E.; Wu, Chunder; Kenton, M.A.; Hammersley, R.J. *Transactions of the American Nuclear Society (USA),* 57: 366-367 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

The Semiscale experimental program conducted by EG & G Idaho, Inc. has been an important contributor to evaluating the behavior of pressurized water reactor (PWR) systems during hypothesized accident sequences. The wide range of accident conditions covered by the tests make them a unique integral source of data for qualifying computer codes used to predict the progression of accidents. The most recent results released from the Semiscale program investigated the anticipated PWR response to a small-break loss-of-coolant accident (SBLOCA) without high pressure injection. The experiment of interest (Semiscale MOD-2C S-NH-1) represents a serious challenge to any computer code since all major modes of natural circulation were observed: single phase, two phase, and reflux. In this investigation, MAAP-DOE was used to compare with the Semiscale S-NH-1 test results. The MAAP-DOE code incorporates the physical models for the many phenomena that could occur in light water reactor severe accidents to analyze the response of the primary system, the containment, and the adjacent plant buildings to these postulated accidents. This investigation includes a comparison of the primary system and limited secondary side results since the Semiscale apparatus did not attempt to represent the containment or adjacent plant buildings of a commercial PWR.

42166 Experimental and theoretical investigation of melt propagation in rubble beds for application in severe-accident analyses. Ahmed, E.K.S.; Podowski, M.Z.; Lahey, R. Jr. *Transactions of the American Nuclear Society (USA),* 57: 367-368 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

One of the consequences of core heatup and degradation during severe accidents is the formation of a rubblized bed, composed of various materials and particles of different size. As a result of continuous heatup due to the decay heat generation augmented by oxidation reaction, individual materials reach their melting temperatures, liquefy, and relocate downward to cooler core regions. Whereas the relocation of most of the low-melting temperature materials occurs very quickly, the melting process of ZrO_2 and UO_2, their relocation, and interaction with solid debris particles is relatively slow. In particular, the release of molten fuel from the corium may be delayed due to the formation of a solid crust separating the molten fuel above from the lower reactor sections. Needless to say, the time history of fuel melting and release may have a profound effect on the overall accident consequences. The purpose of this paper is to present the results of experimental simulation and analytical/numerical analysis of the interaction between a rubble bed and a penetrating (and partially freezing) liquid. In the experiments, two different materials were used to stimulate a rubble bed consisting of spherical particles, i.e., paraffin and glass. The bed was subjected to molten paraffin droplets, injected from the top. The droplets were partially freezing when flowing through the bed. The combined melt relocation and solidification processes were studied parametrically, including the effect of such parameters as, bed porosity, melt temperature, relative subcooling of solid particles, velocity, and mass flow rate.

42167 Analysis of the late core melt progression phase of severe reactor accidents using the MELPROG code. Dosanjh, S.S. *Transactions of the American Nuclear Society (USA),* 57: 368-369 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

The two-dimensional (r-z) melt progression (MELPROG) computer code is being developed to analyze severe light water reactor accidents from accident initiation through vessel failure. The MELPROG code is comprised of several explicitly linked modules that analyze different aspects of an accident. If the fuel rods fragment, as happened at Three Mile Island (TMI), core melt progression is analyzed in the DEBRIS module (this module is also used to model rubble beds that can form in the lower plenum). Heat transfer, oxidation, melting, dissolution, melt relocation, and refreezing are all considered in the DEBRIS module. Vapor and coolant flow in the core and through the vessel are treated in the FLUIDS module. This module also models the relocation of solid and molten materials from the reactor core into the lower plenum. Detailed heat transfer and structural mechanics calculations are performed in the STRUCTURES module for the vessel walls, various support plates, the core baffle, the core barrel, core support columns, and other structures in the vessel. Three-dimensional, dynamic view factors are calculated in the RADIATION module that provides boundary conditions for the CORE, DEBRIS, and STRUCTURES modules. Results from a sample calculation are presented to demonstrate the capabilities of the code.

42168 Spreading of molten corium in MK I geometry following vessel melt-through. Sienicki, J.J. (Argonne National Lab., IL (USA)); Farmer, M.T.; Spencer, B.W. *Transactions of the American Nuclear Society (USA),* 57: 369-370 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

For Mk I boiling water reactor severe-accident sequences in which molten corium is postulated to melt through the reactor pressure vessel (RPV) lower head, an important question concerns the relocation of the corium material that drains from the vessel. After filling the sump pits located in the pedestal concrete floor beneath the RPV, the molten corium that collects on the pedestal floor is generally free to flow through the doorway, which provides personnel access to the pedestal, and to spread out over the concrete floor in the annular region between the pedestal wall and the steel liner of the containment shell. A significant issue is whether the corium, after exiting the doorway, can spread under gravity all the way to the liner where thermal attack on the liner steel might be postulated to occur. A computer code (MELTSPREAD) has been developed to investigate the spreading dynamics and thermal interactions of a molten corium layer flowing horizontally over an ablating concrete substrate that may be initially covered with water. The principal objective is to predict, for specific conditions of corium composition, mass, and temperature, the lateral penetration of the corium that drains from a localized hole in the lower head immediately following RPV failure.

42169 Analysis of fission product revaporization in a BWR reactor cooling system during a station blackout accident. Yang, J.W. (Brookhaven National Lab., Upton, NY (USA)); Schmidt, E.; Cazzoli, E.; Khatib-Rahbar, M. *Transactions of the American Nuclear Society (USA),* 57: 370-372 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

A preliminary analysis of the re-evaporization of volatile fission product from a boiling water reactor (BWR) cooling system following a core meltdown accident in which the core debris penetrates the reactor vessel has been performed. The BWR analyzed has a Mark I containment and the accident sequence was a station blackout transient. This work was performed as part of the phenomenological uncertainty study of the Quantification and Uncertainty Analysis of Source Terms for Severe Accidents program at Brookhaven National Laboratory. Fission product re-evaporization was identified as one of the important issues in the Reactor Risk Reference Document.

42170 Effects of nonablation concrete outgassing on BWR Mark I debris/concrete interactions during severe accidents. Hyman, C.R. (Oak Ridge National Lab., TN (USA)); Carroll, D.E.; Washington, K.E. *Transactions of the American Nuclear Society (USA),* 57: 372-373 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

Two limitations in current corium-concrete interaction (CCI) modeling methodology have been recently identified as having a potentially larger impact on CCI calculations for the boiling water reactor (BWR) Mark I containment design. These limitations are extant in the CORCON module of the CONTAIN computer code. The calculations in this paper were performed with CONTAIN/OR, a variant of the released version of CONTAIN 1.1. The CONTAIN/OR code incorporates modifications to the CORCON/CONTAIN coupling at the corium/concrete interface and provides a new treatment of concrete degassing. The changes were developed to facilitate exploration of the MARK I corium spreading issue and to support Oak Ridge National Laboratory's scoping calculations for the task group on the BWR Mark I shell melt-through issue. It is assumed that mechanistic detail is not needed to capture the dominant effects of concrete degassing and that a simple release model, aimed at providing a first-order approximation of gas sources from heated concrete to the melt, will provide the capability to assess the importance of this effect. Interfaces were developed between this new model, the embedded version of CORCON in CONTAIN, and the other portions of the CONTAIN cavity model.

42171 Analysis of choking in two-phase flow. Lahey, R.T. Jr. *Transactions of the American Nuclear Society (USA),* 57: 380-383 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

The ability to accurately predict two-phase critical flow rate is important in the analysis of many hypothetical nuclear reactor accidents. In the past, mixture and drift-flux models were used in light water nuclear reactor (LWR) safety analyses. Thus the choking condition could be easily evaluated. Currently, two-fluid models are widely used in the evaluation of LWR accidents (e.g., TRAC, RELAP5). It is the purpose of this paper to present the choking condition implied by two-fluid models and to relate the resultant sonic velocity to other well-known formulations. It is shown that virtual mass effects are quite important and must be carefully modeled if accurate predictions of critical flow are to be made. A simple analytical expression for the local sonic velocity has been derived that includes all important effects. Moreover, this model can be reduced to other known models in the literature.

42172 Reflooding heat transfer in zirconium alloy rod bundles of the VVER reactor. Zemlianoukhin, V.V.; Kabanov, L.P.; Makarovsky, P.L.; Mordashev, V.M.; Rybakov, Yu.V. *Transactions of the American Nuclear Society (USA),* 57: 384 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

Heat transfer experimental research in seven-rod bundles of Zr + 1% Nb alloy has been carried out at different kinds of water injections: bottom, top, and combined. The rod bundle characteristics are defined, and the range of experimental parameters chosen are described. The results of current experimental research are several empirical correlations for calculations of rewetting velocity, heat transfer coefficient downstream of quench front and heat transfer enhancement due to grid spacers at the bottom reflooding conditions.

25 ENERGY STORAGE

42173 (IREQ–7403) **Symposium. Energy storage.** Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). 1974. vp. (In French). (CONF-7403113–: Stockage de l'energie, Varennes (Canada), 20 Mar 1974; CE–02476). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This symposium concerns energy storage, mainly off-peak energy storage. The energy needs of Hydro-Quebec's grid according to time and the regulation of this grid are presented. The specific means of off-peak energy storage discussed are pumped hydroelectric storage, compressed air storage in underground caverns (Magdalen Islands), heat storage, the pyrolysis of wastes to produce gas or low sulfur oil, high-energy-density batteries, and the production of hydrogen through electrolysis. Energy storage in flywheels is also examined, both for off-peak energy storage and for the propulsion of vehicles. Separate abstracts have been prepared for 11 papers from this symposium.

2502 Compressed Gas

Refer also to citation(s) 41913

42174 (IREQ–7403, pp. 14) **Electrical energy storage at the Magdalen Islands.** Leigh, C. (Inst. de recherche de l'Hydro-Quebec, PQ, Canada). Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). 1974. (In French). (CONF-7403113–: Stockage de l'energie, Varennes (Canada), 20 Mar 1974; CE–02476). In *Symposium. Energy storage.* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

Energy can be stored in the form of compressed gas. Aproposed system is described whereby compressed air or compressed hydrogen would be stored in cavities dug within the salt domes that have been discovered under the Magdalen Islands. A typical installation would comprise a compressor, an alternator, and an air turbine, with possibly a regulating reservoir to feed the turbine with air at constant pressure. This air should be heated in a combustion chamber before entering the turbine. The dimensioning of the system and the problem of condensation of water from air are discussed. 1 ref., 7 figs., 1 tab.

2503 Pumped Hydro

Refer also to citation(s) 41913

42175 (IREQ–7403, pp. 15) **Utilization of a hydroelectric production grid.** Pronovost, G.A. (Inst. de recherche de l'Hydro-Quebec, PQ, Canada). Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). 1974. (In French). (CONF-7403113–: Stockage de l'energie, Varennes (Canada), 20 Mar 1974; CE–02476). In *Symposium. Energy storage.* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

A computerized planning model which is designed to optimize the operation of a hydro-electric network. The model is designed to facilitate planning in the long term, middle term, short term, and very short term. It also helps optimize real time operations of water storage and usage, in networkes having hydroelectric and thermal prower production. . 7 figs.

42176 (IREQ–7403, pp. 17) **Role and operation of pumped storage power plants.** Leclerc, G. (Inst. de recherche de l'Hydro-Quebec, PQ, Canada); Pare, S. Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). 1974. (In French). (CONF-7403113–: Stockage de l'energie, Varennes (Canada), 20 Mar 1974; CE–02476). In *Symposium. Energy storage.* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

The pumped reserve power plant is the most common type of accumulator and the only one used on a large scale by electrical utilities. Pumped power plants are competing with other types of peak load equipment, especially gas turbines. This paper describes pumped reserve power plants, their production cycles (daily, weekly, and yearly), and their availability. A pumped power plant may be optimized from the point of view of the needs of the power grid or from the point of view of the site; the characteristics to consider are the capacity of the plant, the template of utilization, and the value of the electricity produced. Other less important characteristics are the start-up and slowing-down times, the contribution of the plant to the stability of the grid, and its "turning reserve". The costs of pumped power plants are discussed. One can distinguish rapidly between good and bad sites by the ratio of the horizontal distance between basins to the head. The factors in the choice of a site are summarized. Three main regions of interest in Quebec are defined: Estrie, the Laurentides near Quebec City, and the Laurentides between Saint Jerome and Mont Laurier. The environmental impacts of the plants are summarized. With a relatively small investment, pumped power plants allow a better utilization of the basic power plants. In industrialized countries pumping may revive hydroelectrical equipment.

2505 Flywheels

42177 (IREQ–7403, pp. 17) **The energy storage capacity of inertial wheels.** Jean, B. (Inst. de recherche de l'Hydro-Quebec, PQ, Canada). Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). 1974. (In French). (CONF-7403113–: Stockage de l'energie, Varennes (Canada), 20 Mar 1974; CE–02476). In *Symposium. Energy storage.* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This paper begins with a brief history of energy storage in flywheels. The interest in this mode of energy storage has been revived by the discovery of new materials with a higher value of σ/rho where σ is the elastic limit of the material, and rho its density. The maximum amount of stored energy per unit mass (specific energy) is k σ/rho, where k is a dimensionless coefficient depending on the shape of the wheel; values of k for different shapes are listed. With steels, 27 Wh/lb can be reached, whereas with the new composite PRD-49, 150 Wh/lb can be reached. The advantages of this type of energy storage are listed; in particular, its specific energy is higher than that of batteries. A project of urban vehicles is described, with a stored energy of 6.7 kWh, a range of 110 miles, and a maximum speed of 70 mph. One of the means to avoid the gyroscopic effect associated with the flywheel is to use two flywheels turning in opposite directions. The problem of the energy dissipation in the case of an accident is considered. In the case of flywheels used as buffer reserves in the electrical distribution grid, the total amount of stored energy must be much higher, but the safety problem is less acute. A project is described, with a stored energy of 20 MWh, a mass of 200 tons, and a rotational speed of 3500 rpm; turbine technology is a starting point in designing such a system. The transfer of energy between the flywheel and the grid is discussed. INRS-Energie intends to build a prototype next year. 3 refs., 9 figs., 3 tabs.

2506 Thermal

Refer also to citation(s) 41865, 41876, 41878, 42308, 42309

42178 (IREQ–7403, pp. 8) **Thermal storage.** Bonneville, J. (Inst. de recherche de l'Hydro-Quebec, PQ, Canada). Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). 1974. (In French). (CONF-7403113–: Stockage de l'energie, Varennes (Canada), 20 Mar 1974; CE–02476). In *Symposium. Energy storage.* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This paper is a summary of the communications presented at the Hydro-Quebec Research Institute, March 1974 symposium, on the subject of thermal energy storage. The reasons for storing thermal energy, the sources and uses of thermal energy, storage methods and materials, and economic aspects are discussed. Lists of substances useable for specific heat storage, latent heat storage, and thermal insulation are given. Solar and wind energy storage have been considered for the heating of houses; cost and yield are not the only design factors to be considered. 8 refs., 3 figs., 4 tabs.

42179 (ITL–8509) **Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.** Intertask Ltd., Ottawa, ON (Canada). 1985. V (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Enerstock conference reports on research efforts initiated to answer the technical questions restraining the realization of potential benefits of seasonal thermal energy storage applications, and to evaluate the performance of seasonal storage as a component in actual systems. The papers present the design, construction, operation, and evaluation of a variety of field experiments and full-employ various storage types, energy sources, heating and cooling loads, system designs, and operating strategies. A total of 104 papers are presented covering sessions on energy storage in aquifers, water

bodies, ice, and ducts, as well as systems. Separate abstracats have been prepared for 104 papers.

42180 (ITL–8509) **Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Abstracts.** Intertask Ltd., Ottawa, ON (Canada). 1985. 210p. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00268). Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Abstracts for 104 papers presented at the Enerstock 85 Conference on thermal energy storage and systems are given. French language papers have both English and French abstracts.

42181 (ITL–8509 vp) **A finite difference model for stratified chilled water thermal storage tanks.** Truman, G.R. (Univ. of New Mexico, Alburquerque, NM, USA); Roybal, L.G.; Wildin, M.W. Intertask Ltd., Ottawa, ON (Canada). 1985. (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A simple numerical model was developed to predict the performance of stratified chilled water storage tanks. The model accounts for the primary factors than influence performance, including: conduction heat transfer and energy storage within the walls and floor; vertical conduction in the water; convective heat transfer between the water and the tank surfaces it contacts; mixing near the inlet diffuser; and heat transfer through resistive elements representing conductive or convective processes between the outer surfaces of the tank and its surroundings. The model was verified for 14-ft deep, 16,000-gal poured concrete tanks and 3-ft deep, 150-gal scale model tanks. Water temperature distributions and tank outlet temperatures were predicted satisfactorily for a variety of operating strategies and flow rates. Thermal efficiencies during repeated cycles of operation were predicted to within 8%. This model is thought to be applicable to heated storage and to larger tanks. With appropriate caution, it is also applicable to tanks with a variety of plan geometries equipped with a variety of diffusers. 6 refs., 5 figs.

42182 (ITL–8509, pp. 466-470) **Latent heat storage in finned tubes.** Ismail, K.A.R. (DEM-FEC-UNICAMP, Brasil); Alves, C.L.F. Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In an attempt to increase the heat transfer rate and reduce the convective currents of freezing in phase change material storage tanks, externally finned circular tubes are being studied. The heat transfer process dominated by conduction is solved by applying control volume techniques to the enthalphy formulation. The equation obtained is applicable to the phase change material in both the solid and liquid phases as well as to the metallic fins. Numerical calculations are done using the alternating direction implicit approach. The parameters analyzed include number of fins, fin length, fin width, compactness ratio, and finally, the difference between the phase change temperature and the wall temperature. An experimental rig was designed and instrumented in order to compare with the numerical results and verify the validity of the model proposed. Good agreement was found between the experimental and the numerical results. The use of finned tubes in phase change storage tanks increases the rate of heat charge or discharge. 6 refs., 9 figs.

42183 (ITL–8509, pp. 589-593) **A concise method for evaluating the heat loss from bermed heat storage tanks.** Rosen, M.A. (Univ. of Torotno, ON, Canada); Hooper, F.C. Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A concise method for evaluating the heat loss from bermed heat storage tanks has been developed. This method, which is an extension of a previously developed method for evaluating the heat loss from bermed tanks, is analytical rather than numerical in form. It is anticipated that this method for calculating the heat loss from partially buried bermed storage tanks will prove useful to designers. Using the present method, a simple mathematical expression is used to evaluate the increase in tank heat loss rate occuring when an in-ground tank is repositioned at a higher level and bermed. The expression is calibrated for a range of berm heights, soil conductivities and insulation thicknesses. A principal advantage of the new method is that, it can be incorporated directly into computer models for calculating tank heat loss. 6 refs., 4 figs., 2 tabs.

42184 (ITL–8509, pp. 584-588) **Strains in the rock around an unlined hot water storage cavern.** Rehbinder, G. (Swedish State Power Board, Vaellingby, Sweden). Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

When an unlined rock cavern is used as a hot water store the rock is exposed to thermal strains. The main threat to the stability of the rock is the fact that the temperature varies cyclically. An investigation of this phenomenon is being carried out at two hot water storage facilities in Sweden. In one of them, the Avesta plant (15000 m^3), the test period extends from the beginning of 1982. In the other one, the Lyckebo plant (100 000 m^3), the test period has been running from the beginning of 1983. The Avesta store is a conventional rock cavern, while the design of th Lyckebo store is unique, in that it is annular and the central pillar supports the overburden. During initial heating compression develops in the rock at some distance from the cavern but this compression becomes expansion as the heating continues. The results also confirm the theoretical conclusion that cyclic loading only causes strain variations in the immediate vicinity of the cavern. It is concluded that strains are mainly dictated by the average temperature of the stored water and not by the temperature variations. It is also concluded that comparitively large shear and normal strains occur at rock joints. 14 refs., 6 figs.

42185 (ITL–8509, pp. 579-583) **The Avesta research plant for hot water storage. Summary of research, 1982-1985.** Martna, J. (Swedish State Power Board, Vaellingby, Sweden). Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The research plant for hot water storage is situated in an unlined rock cavern in the town of Avesta in central Sweden. The plant has been in operation since May, 1982. The planned research program has been carried out using four-month temperature cycles from 30 to 93^{0}C and two week cycles from 70 to 115^{0}C, respectively. The cavern, as well as the surrounding rock, have undergone a vertical

translation of 5-10mm, caused by the increase in the rock temperature. The main stress and strain fields in the rock are due to the average temperature of the stored water. The thermal stratification of the stored water is reasonably stable. The heat losses are gradually declining. The average value for 1984 was about 15 per cent. It will take bout 4 years for the Avesta system to reach the steady state, i.e. it will be approached in 1986. Deposition of mineral substances outside the cavern has been negligible. The outflow of the storage water to the surrounding rock has been about 12 1/min. Of the construction materials, dip galvanized steel and aluminium exhibited heavy corrosion, carbon steel significant, copper and copper alloys slight and stainless steel negligible corrosion. An inspection of the cavern after 20 months of operation showed some superficial damage to rock and shotcrete. The cavern was in a good, functional condition. Physiological studies were made on the working and diving conditions in the hot cavern. 17 refs., 4 figs.

42186 (ITL–8509, pp. 573-578) **Heat storage and extraction from the abandoned water-filled mines in Norberg, Sweden. Idea and experiences.** Kjaerboe, P. (VIAK AB, Stockholm). Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The city of Norberg is situated on top of the mines. The mines are slowly being filled with water and expected to be full in 1986. The water volume will be approximately 1 800 000 m^3. A description of the mines, the heat storage system design and experience at the plant are described. The heat extraction system consists of piping in one shaft, a heat exchanger which is necessary due to the chemistry of the mine water, and a cold water distribution system. In the first phase, built in 1984, the distributed water is used as heat source for five heat pumps in different buildings. Calculations show that heat can be extracted up to 2 MW with loading using warm summer water from a nearby lake up to 200 kW average without loading. The heat source demand of the first phase is approximately 2 MW with loading estimated at 200 kW. It will thus be necessary to start reloading within a few years. In the next phase, the heat storage project will be combined with cooling of drinking water in summer. This is necessary as surface water of the lake is used as the water supply. 4 refs., 11 figs.

42187 (ITL–8509, pp. 567-572) **General theory of heat and cold storage.** Hansen, P.N. (Technical Univ. of Denmark, Lyngby, Denmark). Intertask Ltd., Ottawa, ON (Canada). 1985. (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Analytical theory describing the heat (or cold) loss from the different types of thermal storage systems is presented, (tank, pit, cavern, earth, aquifer) is presented. Both short term and long term storage aspects are analysed. The paper concentrates mostly on simple storage geometries like plate, cylinder and sphere to obtain simple analytical heat/cold loss expressions (no integral formulations). Two different types of loss characteristics were noted depending on the thermal capacity of the insulating surroundings of a store. In the case of under-ground storage systems, the thermal capacity of the surrounding ground volume can lead to interesting loss characteristics in discharge operation where the loss can be positive, zero and even negative.

42188 (ITL–8509, pp. 562-566) **Stratfied operation of a 500 M^3 test pit.** Hansen, K.K. (Technical Univ. of Denmark, Lyngby, Denmark); Hansen, P.N.; Ussing, V. Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In this paper the results of measurements and simulations during stratified operation of a 500 m^3 heat storage test pit in Denmark are summarized. Approximately 80 thermocouples measured the temperatures of the water and the soil under and around the pit. In the water, a moveable 1.7 m long tube with 14 thermocouples measured the location of the thermocline. A finite difference technique for calculating temperatures in the water and in the surrounding soil was used. The temperature variation in the water was simulated using the superposition principle to separate the influence of the convective movement cased by water inlet/outlet and the thermal effects of heat conduction in the water plus heat losses to the ground. The experimental results as well as results of numerical simulations for one charge and discharge operation are presented. Good agreement between measurements and simulations was found and it may be concluded that the applied computer model may be used during simulations of the thermal behaviour of this type of storage pit. 6 refs., 2 figs.

42189 (ITL–8509, pp. 549-553) **Synergism of a thermal energy store with a central-heating boiler.** Cohen, R.R. (Cranfield Inst. of Technology, Bedford, U.K.); Tanton, D.M.; Probert, S.D.; Nevrala, D.J. Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper describes the benefits of interposing a thermally-insulated heat store in the circuit between a central-heating boiler and a hydronic heat-distribution system. These benefits include energy savings resulting from less frequent on-offcycling, of the boiler and the use of a smaller boiler to satisfy the heating needs of the building. The installation of a heat store which is capable of absorbing at maximum around 2 hours of full output from the boiler in the thermal circuit between a boiler and its thermal-demand load would: reduce, by at least 40%, the boiler capacity required for a gien building; increase the annual boiler efficiency to almost its peak, full-load value; allow rapid building pre-heating to occur; simplify the necessary system controls; and smooth the early morning peak demand on gas distribution networks, allowing more customers to be supplied by the existing distribution mains. The performance of a full-scale trial has been monitored during consecutive winters, before and after the installation of a 3300 litre hot-water store and the simultaneous removal from service of 2 of a set of 5 modular boilers. This paper analyses the improvements in overall system efficiency achieved by the introduction of the heat storage and the influence of system flow rate and control strategy on efficiency. The monitored data have been used to validate and refine computer simulations of such heating systems both with and without storage. Parameter sensitivity studies are briefly described. Finally, the technology is economically assessed and conclusions are drawn as to which applications are most likely to be attractive financially. 3 refs., 7 figs.

42190 (ITL–8509, pp. 544-548) **Experimental study of a storage reservoir simultion model.** Cayron, L. (Onera-Cert, Toulouse Cedex); Pauzin, S. Intertask Ltd., Ottawa, ON (Canada). 1985. (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Research conducted in a basin on an actual site was used to produce a general model of a storage facility and its thermal behaviour. An improved model was used to examine a reservoir that includes injection and tapping. First, by writing equations that govern thermal and dynamic transfer, the simulation parameters for seepage, limiting conditions and geometric configuration were defined. Radiative transfer was also taken into account. The vertical distribution of temperatures and the response times were obtained for many configurations with and without covers. These configurations include, homogeneous storage with and without tapping; insolated homogeneous storage with and without tapping; stratified storage with and without tapping; and stratified and insolated storage with and without tapping. The findings were analysed and compared with those cited in the literature and those obtained empirically on site. 12 refs., 9 figs., 1 tab.

42191 (ITL–8509, pp. 539-543) **An experimental study of the effects of an inlet diffuser on performance of horizontal cylindrical hot water storage tank.** Burgeff, D.C. (Univ. of New Mexico, Albuquerque, NM, USA); Wildin, M.W. Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Three inlet flow diffusers designed to help maintain the thermocline in water-filled horizontal cylindrical storage tanks were evaluated experimentally. The study was effected on a scale-model acrylic tank, the corresponding full-scale tank serves a solar water heater. The designs were analyzed during hot water removal via flow visualization techniques and temperature history data. Mixing occurring during the early stages of the removal was dominant with respect to the formation and subsequent behavior of the thermocline. Difficulties were encountered in trying to get a uniform discharge flow using the chosen diffuser designs. Finally, the fact of simply lowering the inlet flow mometum did not avoid the mixing in the tank. Instead it generated new mixing mechanisms. The present study revealed several trends for further optimization in inlet flow diffuser design, aimed at producing and preserving a thermocline in a horizontal tank with curved or sloping side walls and possible operating at different temperature ranges. Further improvement should be possible, using the present study results. 4 refs., 8 figs., 2 tabs.

42192 (ITL–8509, pp. 525-538) **Heat storage in caverns, tanks and pits. An overview of Swedish experiences.** Gustafson, G. (VIAK AB, Gothenburg, Sweden). Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Heat storage in water contained in tanks, pits and rock caverns is a technique that today is applied at several pilot and demonstration projects in Sweden. These systems have been in operation two to five years. The paper describes the state of the art in Sweden. The principal technical solutions for storage of hot water are described and exemplified with different demonstration plants. Various technical problems that have arisen are discussed; some of these have been counteracted during operation, others require alternative technical solutions. The influence on the environment of hot water storage is not expected to be of great significance. Cost reductions are required to make the use of hot water storage wide spread. The paper describes present construction and operation costs for different technical solutions and also the technical modifications suggested to reduce construction costs. 11 refs., 10 figs., 1 tab.

42193 (ITL–8509, pp. 623-629) **Long term heat accumulator in Berlin (West Germany). Storage construction, first results and further developments.** Voigt, B. (Technical Univ. of Berlin, Berlin, West Germany); Ruhnau, R.; Schilf, L. Intertask Ltd., Ottawa, ON (Canada). 1985. (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper presents hydraulic and material fundamentals of a long term heat storage system in Berlin, West Germany. The first results of operation are presented. The different steps of the construction and the measurement system are illustrated. Supported by the installed computerized measurement system, the distribution of temperature, the heat flows inside the constructions, and the surrounding soil are demonstrated. The dimensioning and necessity of thermal insulation in the different parts of the store are discussed. The floating cover consists of evacuated stainless steel elements (vacuum super insulation). The excellent behavior of their thermal heat insulation allows further extendible applications, especially for the storage wall constructions and the pipes. As a result of existing research work, it is possible to design linings out of bentonite layers according to their specific considerations. Dimensioning methods are presented. Economic considerations regarding the performance of long term heat accumulators are discussed. 4 refs., 12 figs.

42194 (ITL–8509, pp. 618-622) **Experience of heat loss from and temperature distribution in a water-filled density-stratified rock cavern.** Vasseur, B. (Swedish State Power Board, Alvkarleby, Sweden). Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The heat storage in a 15,000 m^3 rock cavern at Avesta, Sweden utilizes the density difference between water of different temperatures to store energy as warm water above cooler water. In order to get a satisfactory function of the store, the heat loss must not be too great and the density stratification must be preserved as intact as possible. Experiences from measurements during two and a half years, with both short and long cycles, are shown in this paper. A numerical model is presented, which gives results in good agreement with the measurements. This includes not only the energy budget and the temperature distribution around the cave, but also the temperature stratification inside the cave. There have not been any problems with the stability of the thermal stratification, either during the long or the short cycles. Numerical calculations indicate that the main destabilizing effect has been the heat loss itself and not the natural convection created by that heat loss. 3 refs., 9 figs., 2 tabs.

42195 (ITL–8509, pp. 605-612) **Diurnal thermal storage.** Tamblyn, R.T. (Engineering Interface, Ltd., Toronto, ON, Canada). Intertask Ltd., Ottawa, ON (Canada). 1985. (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.*

The use of thermal storage in North America is being hastened by utilities with the advent of more demand sensitive electric rates and time of use premiums. The growth of storage has been principally for cooling although heat reclaim is an adjunct of some systems. Ice is competing strongly with chilled water for cool storage applications. This paper outlines those situations that most favor the use of diurnal storage today and comments upon the pros and cons of ice vs water. 18 figs., 3 tabs.

2509 Batteries

Refer also to citation(s) 42289, 42788

42196 (AD-A–205468/2/XAB) **Viscosity and conductance of MEICL/$AlCl_3$ melts containing nonaqueous solvents. Technical report, 1 September 1987-1 May 1988.** Dymek, C.J.; Godec, G.E. Frank J. Seiler Research Lab., United States Air Force Academy, CO (USA). 26 May 1988. 17p. (FJSRL-TR–88-0003). Available from NTIS, PC A03/MF A01.

Ionic liquids formed by mixing 1-methyl-3-ethylimidazolium chloride (MEIC1) with $AlCl_3$ are of interest as electrolytes for batteries. Enhanced conductivities of these melts were observed upon addition of the solvents, benzene, acetonitrile, and dichloromethane. Conductivities and viscosities of these melt/solvent solutions were measured as a function of mole fraction of solvent and found to have similar functional dependence. A model for benzene-ion and ion-ion interactions in the solutions is proposed to explain the variations in the interdependence of conductivity and viscosity in the benzene-melt solutions.

42197 (AD-A–205756/0/XAB) **Investigation of LI/SO2 cell hazards. 3. Raman spectroscopy of lithium dithionite. Report for June 1985-January 1986.** Kilroy, W.P.; Chmielewski, S.A.; Bennett, D.W. Naval Surface Warfare Center, Silver Spring, MD (USA). 1 Sep 1988. 41p. (NSWC-TR–88-76). Available from NTIS, PC A03/MF A01.

Preparation of pure lithium dithionite was investigated using several synthetic methods. Raman spectroscopy reveals that lithium dithionite undergoes a low-temperature lattice transformation that demonstrates the existence of two forms of dithionite. Transition-metal ions were briefly evaluated as a first step in altering the SO_2 reduction mechanism or for stabilizing dithionite.

42198 (AD-A–205866/7/XAB) **Preparation, characterization, and performance of MoS_3 as an active cathode material. Final report, 15 June 1985-14 December 1988.** Pollak, F.H. Brooklyn Coll., NY (USA). 14 Feb 1989. 61p. Available from NTIS, PC A04/MF A01.

The author report on a program of the preparation, characterization and performance of amorphous MoS_3 (a-MoS_3) as an active cathode material. For the first time, thin films (approx. 1 micro of a-MoS_3) were prepared. This was accomplished by electrodeposition from both aqueous and non-aqueous solutions of $(NH_4)2MoS_4$ (ATTM) at room temperature. These thin films were studied by several experimental methods including x rays, Raman scattering, optical transmission and electrolyte electroreflectance.

42199 (AD-A–207119/9/XAB) **Fundamental electrochemical investigation of bromoaluminate and mixed chloro-bromoaluminate room-temperature molten-salt systems. Technical report, January 1987-August 1988.** Boon, J.A.; Wilkes, J.S.; Lanning, J.A. Frank J. Seiler Research Lab., United States Air Force Academy, CO (USA). Mar 1989. 105p. (FJSRL-TR–89-0004). Available from NTIS, PC A06/MF A01.

In this project, the chemical and electrochemical properties of the bromoaluminate molten-salt system were determined. With knowledge of the bromide system, the chemical and electrochemical properties of the mixed chloro-bromoaluminate molten salt system were determined, allowing further work on the applicability of these systems as electrolytes in high-density electrical storage devices. The qualitative electrochemical behavior of the bromide and chloride systems were compared. The systems were found to behave similarly, but the basic bromide system had two oxidative processes, compared to the single process of the chloride system. The bromide system was also shown to have a smaller electrochemical voltage window.

42200 (CONF-8605368–) **Electrochemical energy sources V.** Busse, H. (ed.). Bundesakademie fuer Wehrverwaltung und Wehrtechnik, Mannheim (Germany, F.R.). 1986. 241p. (In German). From 5. symposium on military engineering: electrochemical energy sources; 26-28 May 1986. Order Number DE89910815/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; NTIS (US Sales Only), PC A11.

The specialized lectures were concerned with the following topics: 1. Service-free lead batteries with fixed electrolytes, 2. sealed lead batteries for industrial truck drives, 3. Sealed lead batteries with coiled electrodes, 4. Active batteries in ammunition, 5. State of the art in Li/SO_2 batteries, 6. Lithium thionyl chloride batteries, 7. Lithium manganese dioxide batteries, 8. Lithium thionyl chloride batteries for weak discharge currents, 9. Primary batteries used in the German Federal Armed Forces, 10. The checking of batteries in the military sector, 11. Material conservation concept for batteries in the navy, 12. Activable silver zinc batteries for the torpedo DM 3, 13. Sintered nickel cadmium batteries, 14. Battery systems and environmental issues, 15. Nickel cadmium batteries with fibre structure electrodes, 16. Battery control and 17. Improvement of the readiness for the use of tactical vehicles in times of peace. (orig./GG).

42201 (EPRI-CU–6330) **Evaluation of electric vehicle battery systems through in-vehicle testing: Fourth annual report: Final report.** Whitehead, G.D.; Blickwedel, T.W. Electric Power Research Inst., Palo Alto, CA (USA); Electrotek Concepts, Inc., Chattanooga, TN (USA). Electric Vehicle Test Facility. c Jun 1989. 61p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This fourth annual summary report documents the tests performed from October 1987 through September 1988 in EPRI's ongoing project to evaluate and compare the performance of near-term electric vehicle traction battery packs in a real-world operating environment. Detailed test procedures and test data are available from EPRI in an informal data report. Testing includes initial acceptance testing of battery components and systems, daily in-vehicle operation of the batteries, monthly in-vehicle driving range tests, and periodic static (constant current) discharge tests under computer control. Battery performance data is typically presented on the basis of calculated specific energy output on a controlled discharge test versus accumulated vehicle/battery miles, and also on the vehicle driving range over fixed operating cycles such as the SAE J227a "C" cycle and at 35 mi/h constant speed. Other operating parameters, such as battery thermal characteristic and battery maintenance requirements (water addition), are monitored and reported. Battery modules in the pack are replaced when their measured ampere-hour capacity at a fixed discharge rate drops to 60 percent of the manufacturer's rated value. The life of a test battery pack is terminated when 25 percent of the modules in the pack have been replaced or require replacement. During this reporting period four lead-acid batteries completed life testing. 18 figs., 8 tabs.

42202 (IREQ–7403, pp. 17) **Electrical energy storage with high energy density batteries.** Gauthier, M. (Inst. de recherche de l'Hydro-Quebec, PQ, Canada). Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). 1974. (In French). (CONF-7403113–: Stockage de l'energie, Varennes (Canada), 20 Mar 1974; CE–02476). In *Symposium. Energy storage.* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

Accumulators are discussed with the following conclusions. The cost and life span of lead accumulators are unsatisfactory with respect to peak load energy storage and car propulsion. Molten electrolytes are preferred to organic electrolytes. The types of high density accumulators currently under study are sodium-sulfur (Ford and Dow Corning) and lithium-sulfur. The energy density achieved is 220 Wh/kg and the power density achieved is 100 W/kg. It is estimated that a life span of five to ten years and a number of charge/discharge cycles in excess of 2000 can be reached. With these figures, an American economic study shows that accumulators could be competitive with pumped reserve storage and gas turbines for peak load energy production. Other advantages of high-energy-density accumulators are listed. The market for these accumulators in the USA could be as high as $13 billion/y. Research projects throughout the world are also listed. A research project has been started at the Hydro-Quebec Research Institute to improve the life span of sodium-sulfur accumulators. 7 figs., 1 tab.

42203 (NEI-DK–178, pp. 15-45) **Intercalation compounds. Metal ions in chalogenide and oxide hosts.** West, K. (Institute of Physical Chemistry, The Technical University of Denmark, Lyngby (DK)). Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysisk Lab. 3; Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysik-Kemisk Inst. Apr 1989. (In Danish, English). In *Solid state sodium*

cells. Order Number DE89902277/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

EFP-84; EFP-85; EFP-86; EFP-87.

This review article deals with the fundamental aspect of intercalation: The influence of the dimensionality of the host structure, composition ranges for the formation of new phases and for staging compounds, the dependence of the electromotive force on oxidation number of the host metal atoms, on the degree of intercalation and on the structure. The treatment covers metal intercalation in general. (author) 124 refs.

42204 (NEI-DK–178, pp. 47-58) **Solid state sodium batteries.** Skaarup, S. (Physics Laboratory III, Technical University of Denmark, Lyngby (DK)); West, K.; Zachau-Christiansen, B.; Jacobsen, T. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysisk Lab. 3; Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysik-Kemisk Inst. Apr 1989. (In Danish, English). In *Solid state sodium cells.* Order Number DE89902277/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

EFP-84; EFP-85; EFP-86; EFP-87.

Results from experiments on five rechargeable solid state sodium battery systems: Na_xMoS_3, Na_xKCr_3Og, α-$Na_xV_2O_5$, β-$Na_xV_2O_5$ and $Na_{1+x}V_3Og$ indicat the possibility of making batteries with cyclability and rate capability comparable to the better known solid state lithium based systems. Sodium based battery system have the advantage of the lower price of sodium and perhaps also with respect to the main disadvantage is that the theoretical energy density is typically only about half that of the corresponding lithium system. (author) 12 refs.

42205 (NEI-DK–178, pp. 59-67) **Solid-state sodium cells - an alternative to lithium cells?.** West, K. (The Technical University of Denmark, Lyngby (DK)); Zachau-Christiansen, B.; Jacobsen, T.; Skaarup, S. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysisk Lab. 3; Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysik-Kemisk Inst. Apr 1989. (In Danish, English). In *Solid state sodium cells.* Order Number DE89902277/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

EFP-84; EFP-85; EFP-86; EFP-87.

The cycling properties of laboratory cells based on insertion of sodium into vanadium oxides using polymer electrolyte at 80 deg. C are reported. In the best system: Na /PEO, $naClO_4$ /V_2O_5 (modified), C high reversibility, and an energy density comparable to the Li/TiS_2 system have been obtained. (author).

42206 (NEI-DK–178, pp. 81-92) **Lithium and sodium insertion into layered potassium vanadates.** Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysisk Lab. 3; Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysik-Kemisk Inst. Apr 1989. (In Danish, English). In *Solid state sodium cells.* Order Number DE89902277/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

EFP-84; EFP-85; EFP-86; EFP-87.

Two new layered potassium vanadates, $K_3V_5O_{14}$ and KV_3O_8 have been studied as electrode material for rechargeable solid state sodium or lithium cells. K_3V_{5O14} is a very open structure with ample room for inserted ions, but the very open interlayer space does not offer the shielding for interionic electrostatic forces necessary for stabilizing the structure with an appreciable amount of ions intercalated. KV_3O_8 offers very high stoichiometric capacities for both lithium and sodium insertion, but the structure is only marginally stable, and cycling rapidly leads to loss of crystallinity of the host lattice. Apparently the cycling properties of electrodes using this material is not limited by this property. (author).

42207 (NEI-DK–178, pp. 93-99) **Lithium and sodium insertion into $Cu_2V_2O_7$.** Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysisk Lab. 3; Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysik-Kemisk Inst. Apr 1989. (In Danish, English). In *Solid state sodium cells.* Order Number DE89902277/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

EFP-84; EFP-85; EFP-86; EFP-87.

The copper vandate was chosen as a representative of electrode materials with more than one transition metal. This material forms a very open structure with room for the accommodation of foreign atoms. Both lithium and sodium intercalation has been performed. Lithium intercalation shows a potential minimum on discharge perhaps indicating the nucleation of a new phase. Both the gravimetric and volumetric energy densities are quite high, primarily because of the wide intercalation range. The ability to insert sodium is somewhat smaller (X_{max}=4), but the energy density of the sodium couple is still above 1000 Wh/l Cycling experiments imply the easier reversibility of the lithium compound. (author) 10 refs.

42208 (NEI-DK–178, pp. 103-124) **Sodium conducting polymer electrolytes.** Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysisk Lab. 3; Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysik-Kemisk Inst. Apr 1989. (In Danish, English). In *Solid state sodium cells.* Order Number DE89902277/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

EFP-84; EFP-85; EFP-86; EFP-87.

This section deals with the aspects of ionic conduction in general as well as specific experimental results obtained for sodium systems. The conductivity as a function of temperature and oxygen/metal ratio are given for the systems NaI, $NaCF_3SO_3$ and $NaClO_4$ plus polyethylene oxide. Attempts have been made to produce mixed phase solid electrolytes analogous to the lithium systems that have worked well. These consist of mixtures of polymer and a solid electrolyte. The addition of both nasicon and sodium beta alumina unexpectedly decreases the ionic conductivity in contrast to the lithium systems. Addition of the nonconducting silica AEROSIL in order to increase the internal surface area has the effect of retarding the phase transition at 60 deg. C, but does not enhance the conductivity. (author) 23 refs.

42209 (NEI-DK–178, pp. 131-149) **Design and interpretation of cycling experiments on solid state batteries.** Skaarup, S. (Physics Laboratory III, Technical University of Denmark, Lyngby (DK)). Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysisk Lab. 3; Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysik-Kemisk Inst. Apr 1989. (In Danish, English). In *Solid state sodium cells.* Order Number DE89902277/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

EFP-84; EFP-85; EFP-86; EFP-87.

A solid state rechargeable battery is a complex system consisting of a number of components, and the design and interpretation of cycling experiments must be done with regard to this complexity. The results may depend on a mixture of thermodynamic and transport properties as well as on macroscopic physical properties such as grain sizes, interfacial contact areas and volume fractions of components in composite electrodes. The amounts of active materials and the dimensions of the electrodes should be chosen with regard to the relation between current density and electrode utilization in order to obtain reasonable electrode utilizations at the desired discharge times. The possible limiting processes during the discharge must be taken into consideration in order to prepare experiments that will enable conclusions about the possible use in a practical battery system to be drawn. (author) 16 refs.

42210 (NEI-DK–178, pp. 151-156) **Battery cycling equipment.** Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysisk Lab. 3; Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysik-Kemisk Inst. Apr 1989. (In Danish, English). In *Solid state sodium cells.* Order Number DE89902277/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

EFP-84; EFP-85; EFP-86; EFP-87.

Our automatic cycling equipment for the simultaneous control and measurement on up to 60 cells is described. A combination of local microprocessors and a central personal computer is used. The voltage ranges from -0.05 to 4.5 V with a typical error of < 1 mV, the current can be varied from 100 nA to 200 mA with a typical error of < 3 0/00 of full range. Any combination of potentiostatic and galvanostatic charge/discharge may be used. The data can be presented on a screen, printer or color plotter. (author).

42211 (PB–89-863666/XAB) **Battery electrodes: properties and performance. June 1987-May 1989 (Citations from the COMPENDEX data base). Report for June 1987-May 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 172p. Available from NTISPC N01/MF N01.

Supersedes PB–88-864939.

This bibliography contains citations concerning battery electrodes relative to research and development in electrode technology, chemical solutions, materials improvement, reactions, rechargeability, and reliability. Electrochemical and thermodynamic characteristics, materials testing and evaluation, and corrosion protection are included. (This updated bibliography contains 358 citations, 118 of which are new entries to the previous edition.)

42212 Current distribution at electrode edges at high current densities. Smyrl, W.H. (9511100); Newman, J. *Journal of the Electrochemical Society (USA),* 136(1): 132-138 (Jan 1989).

At current densities large in magnitude and also large compared to the exchange current density, a conducting disk in an insulating plane has a very nonuniform current distribution across the surface. The current distribution near the center is governed predominantly by ohmic effects, but near the edge, electrode kinetics become important. This paper describes the treatment of the current and potential distributions on the electrode, especially near the edge of the electrode where the nonuniformity is most extreme. The electrode kinetics are taken to be in the Tafel region. The results are valid for any and all large values of current density and provide a definitive description of the way in which the current and potential distributions approach the purely ohmically controlled (primary) distributions as the current is increased. The current density at the edge of the disk is found to increase with the square of the average current density. These results for the edge region of a disk at high currents and those of an earlier paper for high exchange currents can be applied to electrodes of more general geometry.

42213 A novel class of organosulfur electrodes for energy storage. Visco, S.J. (9522384); Mailhe, C.C.; DeJonghe, L.C.; Armand, M.B. *Journal of the Electrochemical Society (USA),* 136(3): 661-664 (Mar 1989).

A broad class of organosulfur compounds is discussed which may offer unique advantages as positive storage electrodes in advanced battery systems. The organosulfur electrodes operate between ambient and 150^0C, are inexpensive, and inert to many metals. In addition, the physicochemical and electrochemical properties of the organosulfur electrodes may be varied in a predictable way. At room temperature these materials may be crystalline, liquid, or polymeric. Batteries based on the novel organosulfur positive electrodes and sodium metal negative electrodes have theoretical energy densities ranging from 350 to 600 Wh/kg. The system which has to data been studied in most detail is the sodium/tetra-ethylthiuram disulfide (TETD) couple which has a theoretical energy density of 360 Wh/kg and an open-circuit voltage of 2.3 V. Laboratory cells have been assembled and tested with maximum practical energy densities of over 110 Wh/kg at zero current drain and volumetric energy densities of 0.196 Wh/cm^3. These cells have been cycled between 10 and 90% of available capacity at power densities of 6 Wh/kg at an energy density of 80 Wh/kg and overall energy efficiency of 75%. Some experimental batteries delivered peak power densities of 40-60 W/kg for a period of a minute or more. Further, preliminary testing of batteries using simple alkyl disulfide electrodes have resulted in full charge/discharge cycles at current densities of 10 $mAcm^2$ at 105^0c.

29 ENERGY PLANNING AND POLICY

Refer also to citation(s) 41611

42214 (NEI-NO–84 F3 12) **Norway as the long term supplier of natural gas to Europe.** Norvik, H. (Statoil Group, Stavanger (Norway)). Norsk Petroleumsforening, Oslo (Norway). 1988. (CONF-8808151–: Offshore northern seas conference and exhibition, 23-26 Aug 1988). In *General conference.* Order Number DE89776210/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Major gas discoveries during the last 10 years on the Norwegian continental shelf have established Norway as an important supplier of natural gas to Western Europe. Almost half of the Western European power gas reservoirs, or $3.10^{1/2}$sup $/m^3$, are located in Norway. Europe is self-sufficient in natural gas to the effect of about 75% at the moment, and with Norway's power reserves should have a 60% self-sufficiency early in the next century. Norwegian gas is available to continental Europe and United Kingdom through a system of pipelines ending up in Emden and St.Fergus. The total transportation capacity is currently some 35.0^9m^3per year. This will be extended to some $50.0^9m^3$when the new pipeline system, Zeepipe will connect the Troll field with the main gas transmission systems on the continent. The Zeepipe system will have a landing point in Zeebrugge in Belgium. The new system will be of great importance to Norway as a gas producer and to continental Europe gas consumers. It will, when it comes into operation in 1993, increase Norway's flexibility and strengthen Norway's possibilities to deliver more gas to the Continent in the future.

2901 Energy Analysis and Modeling

Refer also to citation(s) 42262, 42265, 42313

42215 (DOE/PE–0088, pp. 4, Paper 11) **Appropriate comparisons of international energy data.** Podolak, P. USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC (USA). Office of Policy Integration. Dec 1988. In *1988 selected papers and presentations by DOE's Policy Integration Office staff.* Order Number DE89004611/JAW. Available from NTIS, PC A08/MF A01.

In the course of making international comparisons of energy-use efficiencies, insufficient attention has been paid to the necessity of creating a common basis for comparison that accounts for differences in cultures and lifestyles. Often, the addition of even one explanatory variable transforms large differences into small differences. Without that explanatory variable or variables, descriptive statistics are being misused in the comparisons. Misleading comparisons usually fall into one of the following three categories: raw data only - no common denominator given; inappropriate common denominator chosen; and insufficient control information. Examples of corrections for each category are presented. 4 references, 3 figures.

42216 (DOE/PE–0088, pp. 4, Paper 12) **Role of energy costs in the CPI-U.** Podolak, P. USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC (USA). Office of Policy Integration. Dec 1988. In *1988 selected papers and presentations by DOE's Policy Integration Office staff.* Order Number DE89004611/JAW. Available from NTIS, PC A08/MF A01.

The closing value for the Consumer Price Index for All Urban Consumers (CPI-U) for 1987 was 340.4, indexed to a base where 1967 equals 100. Thus, the one-hundred-dollar market basket of expenditures in 1967 had escalated in price to $340.40 by the end of 1987. Over that twenty-year period, two types of changes were happening: different components of that market basket were changing in price at different rates; and the composition of that marketbasket of goods and services was changing, partly in response to those price changes. To assess the role of energy cost changes in the increase from 100 index points in 1967 to 340.4 in 1987, these changes are examined separately and together. Such a disaggregation of the total change permits a clearer focus on the changes in energy-use patterns. The energy effects are also compared to the effects of other major expenditure categories in the market basket. 3 references, 5 figures.

42217 (LBL–27275) **Evaluating energy and non-energy impacts of energy conservation programs: A supply curve framework of analysis.** Vine, E.; Harris, J. Lawrence Berkeley Lab., CA (USA). Jun 1989. 24p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. (CONF-890845–3: 4. international energy conservation program evaluation conference, Chicago, IL (USA), 21-25 Aug 1989). Order Number DE89015221/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Historically, the evaluation of energy conservation programs has focused primarily on energy savings and costs. The recent, increased interest in global environmental problems (e.g., acid rain, ozone depletion, and the greenhouse effect), has made decision makers, as well as program evaluators, sensitive to the environmental impacts of all programs, including energy conservation programs. Economic impacts of programs remain important policy concerns. Many state and local jurisdictions are concerned with the net effects of energy policies on economic growth, jobs, and tax revenues, as well as the impacts of growth and development on

local energy issues (e.g., construction of new power plants). Consequently, policy makers need a methodology to compare easily the energy and non-energy impacts of a specific program in a consistent way, for both retrospective analysis and for prospective planning. We present the general concepts of a proposed new approach to multi-attribute analysis, as an extension of the concept of "supply curves of conserved energy." In their simplest form, energy conservation supply curves rank and display the savings from conservation measures in order of their cost-effectiveness. This simple concept is extended to reflect multiple decision criteria and some important linkages between energy and non-energy policy decisions (e.g., a "supply curve of reduced carbon emissions, "or a "supply curve of net local job-creation"). The framework is flexible enough, so that policy makers can weigh and compare each of the impacts to reflect their concerns, and see the results in terms of program rankings. The advantages of this analysis framework are that it is simple to use, flexible, and replicable. 15 refs., 6 figs.

2902 Economics and Sociology

Refer also to citation(s) 41558, 41559, 42216, 42229, 42230, 42266, 42275, 42285, 42303, 42331

42218 (PTB-W–37) **State and development of gas calorimetry and charging for heating gas. Proceedings.** Hemminger, W. (ed.). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Waerme. Jun 1988. 169p. (In German). (CONF-8712127–: 67. PTB-seminar on state and development of gas calorimetry and charging for heating gas, Braunschweig (Germany, F.R.), 10-11 Dec 1987). Order Number DE89795859/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01.

During this 67th PTB symposium on the state and development of gas calorimetry and charging for heating gas, 14 lectures were given. The titles of the subject areas explained in detail are: Gas calorimeters for measuring the calorific value; calorimetric calibration gas; approval test of gas calorimeters; on determining the calorific value of gases by means of process gas chromatography; process for the production of test gases; calibration gases for use in gas chromatographs as calorific value measurement equipment capable of calibration; long-term sampling by means of an electronic sampler; determining gas data from gas chromatography analysis; experience of the approval test of gas chromatographs as calorific value measurement equipment; preparation of L and H gases according to DVG W G 260; explanations on DVGW Worksheet G 685 sheet I; first experience with computer-aided assignment of calorific values by the GANPRODA program system; assignment of calorific value with the aid of identification measuring positions; the role of natural gas in German energy supplies - economic and legal aspects. A separate abstract was prepared for each of the lectures. (HWJ).

42219 (PTB-W–37, pp. 155-168) **The role of natural gas in German energy supplies - economic and legal aspects.** Bramkamp, F.B. (Bundesministerium fuer Wirtschaft, Bonn (Germany, F.R.)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Waerme. Jun 1988. (In German). (CONF-8712127–: 67. PTB-seminar on state and development of gas calorimetry and charging for heating gas, Braunschweig (Germany, F.R.), 10-11 Dec 1987). In *State and development of gas calorimetry and charging for heating gas. Proceedings.* Order Number DE89795859/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01.

Natural gas, with a 15% share of primary energy consumption, compared to petroleum (43%) and hard coal (20 %) is one of the three mainstays of energy consumption in the Federal Republic of Germany. Extensive tables report on the part of the gas economy in the overall and energy economy development of the Federal Republic. Data are given on primary energy consumption according to energy media, the structure of natural gas sales (public gas economy according to consumption sectors) and obtaining natural gas (from Germany, the Netherlands, Norway, the USSR and Denmark). There are also reports on the European natural gas network (500,000 km), fixing the prices for natural gas (legal situation, development of prices in practice), the structure of the German gas economy (36,000 employees, 57.1 billion DM), reserves of natural gas (no shortage of natural gas is expected in the foreseeable future) and the security of the natural gas supply (not endangered by depending on a single foreign source). Finally, the energy policy aims of the West German Government concerning natural gas are mentioned. (HWJ).

2903 Environment, Health, and Safety

Refer also to citation(s) 41561, 42236, 42237, 42241, 42256, 42362, 42364, 42391, 43368, 43382, 43383, 43397, 43419, 43420, 43457, 43458, 43459, 43460, 43461, 43462, 43463, 43464, 43465, 43466, 43495, 43500, 43502, 43519, 43520, 43521, 43522, 43523, 43524, 43525, 43526, 43527, 43528, 43529, 43530, 43531, 43532, 43533, 43534, 43535, 43536, 43537, 43538, 43539, 43540, 43541, 43544, 43545, 43546, 43634

42220 (AD-A–205411/2/XAB) **Installation-restoration program. Phase 2. Confirmation/quantification. Stage 1 for Minot Air Force Base, Minot, North Dakota. Volume 3. Appendices G through M.** Hart (Fred C.) Associates, Inc., New York, NY (USA). Oct 1988. 299p. Available from NTIS, PC A13/MF A01.

The literature that deals specifically with the geology and hydrogeology of the Minot area was reviewed to provide a comprehensive understanding of past and current developments in this area. The literature review also served to provide a framework within which Hart could conduct further research to more accurately define the geology and hydrogeology of the MAFB area. Over the past 25 years the geology and ground-water resources of North Dakota were studied on a county-by-county basis in a series of cooperative projects between the North Dakota Geological Surveys, the North Dakota State Water Commission, the U.S. Geological Survey and the various Water Resources Districts. The report to the North Dakota Geological Surveys entitled 'Ground Water Resources of Renville and Ward Counties' was produced in conjunction with the state-wide cooperative effort. This report consisted of three parts: Part I - the geology of the counties; Part II - the basic data report; and Part III - describes the location, the extent, the chemical quality, the quantity of water, the relationship between surface and ground water.

42221 (AD-A–205560/6/XAB) **Waste-management practices of the United States Antarctic program. Special report.** Reed, S.C.; Sletten, R.S. Cold Regions Research and Engineering Lab., Hanover, NH (USA). Feb 1989. 36p. (CRREL-SR–89-3). Available from NTIS, PC A03/MF A01.

The United States operates research facilities in Antarctica, at Coastal locations, inland sites, and on the interior snowfield. This report documents the results of 1988 investigations and evaluations of present waste-management practices at these stations and recommends future action. In addition to liquid and solid waste management, the report discusses related water-supply issues.

42222 (EE–1988) **An Act respecting the protection of the environnment and of human life and health. Chapter 22,35-36-37 Elizabeth II.** Environment Canada, Ottawa, ON (Canada). 1988. 96p. (In English and French). (CE–02654). Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report contains the text of the Canadian Environmental Protection Act. It deals with the environmental quality objectives, guidelines and codes of practice, with toxic substances and with nutrients; it lists the duties of federal departments, agencies, and crown corporations, works, undertakings and lands. Finally it deals with international air pollution, ocean dumping, and general arrangements. In appendix to the Act are given lists of toxic, forbidden and restricted substances.

42223 (IVO-A–04/89) **Discussion on politics of energy and environment in Finland in 1974, '79 and '86. Bases for analysis of the discussion, preliminry analysis of empirical material and working-hypotheses.** Kantola, I. Imatran Voima Oy, Helsinki (Finland). May 1989. 158p. (In Finnish). Order Number DE89787753/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

The goal of the study has been to establish a reliable picture of the mediation of messages in politics related to energy and environment in the mass-media of the modern differentiated society. The jounals issued by social movements, industries and professional societies indicate the self-consciousness of their members. To some extent, however, these journals affect also it. In order to describe these relations the main arguments and corresponding changes in these arguments on politics of energy and environment during more than ten last years were discerned. The overall structure of the discussion was outlined from different points of view and theoretical framework. The theoretical structure of the discussion backing up the knowledge and cognition of energy and environmental questions was one of the main results of the study. Some possible alternatives to shape values through aesthetics and through the so-called 'communicative rationality' were also outlined. The second part of the report highlights the mode of shaping consciousness among the different professional, branch-specific and movement-specific journals.

42224 (Juel-Conf–70, pp. 169-176) **Risk communication in the search for a global climate management strategy.** Rayner, S. (Oak Ridge National Lab., TN (USA)). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). 1988. (CONF-8810410–: International workshop on risk communication, Juelich (Germany, F.R.), 17-20 Oct 1988). In *Themes and tasks of risk communication. Proceedings*. Available from Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek.

At the present level of knowledge, particularly in the light of the very high uncertainties among scientists concerning the regional distributions of impacts, it is clear that the climatic change issue ranks high on both systems uncertainty and decision stakes. It seems to be assumed by many participants in both the scientific and policy communities (e.g. by the International Geosphere Biosphere Program) that the reduction of systems uncertainty will make problem resolution more straightforward. However, we should consider that lifting the veil of ignorance about the outcomes of climatic change could make it more difficult to implement any global measures to prevent or adapt to its impacts. (orig./HSCH).

42225 (NEI-NO–89) **Clean air conference 1987.** Norske Sivilingenioerers Forening, Oslo (Norway). 1987. 266p. (In Norwegian). (CONF-8705381–: Clean air conference '87, Lillehammer (Norway), 4-6 May 1987). Order Number DE89902378/JAW. Available from NTIS (US Sales Only), PC A12.

The emission of gaseous wastes from different sources is analysed, and methods for the control and removal of polluting effluents are discussed. An example on monitoring network is given. Separate abstracts are prepared for two papers. 104 figs., 33tabs., 40 refs.

42226 (PB–89-175541/XAB) **Decision making for regulating chemicals in the environment.** National Academy of Sciences, Washington, DC (USA). Commission on Natural Resources. 1975. 244p. Available from NTIS, PC A11/MF A01.

Library of Congress catalog card no. 75-29655.

The intent of this study was to assess the state of the art of decision making to identify inadequacies in current methods, and to make recommendations that could aid EPA and other regulatory agencies in making more-equitable and scientifically sound decisions for controlling chemicals in the environment.

42227 (PB–89-178990/XAB) **Hazardous materials transportation. Annual report, calendar year 1987.** Department of Transportation, Washington, DC (USA). Research and Special Programs Administration. 1987. 159p. Available from NTIS, PC A08/MF A01.

This report describes Department of Transportation (DOT)'s ongoing programs and policies for promoting hazardous materials transportation, safety, contains safety statistics and enforcement data, and lists the regulations, as well as exemptions to the regulations, issued during the reporting year. The report addresses the hazardous materials regulatory program, inspection and enforcement activities, international activities, training and information dissemination, and technology research. Additional appendices include U.S. Coast Guard activities, rulemaking publications issued; penalty actions taken; exemptions or special permits granted and the Memorandum of Understanding between DOT/(Federal Emergency Management Agency) FEMA.

42228 (PB–89-179493/XAB) **Market-driven municipal/industrial waste-management model.** Southern Tier Central Regional Planning and Development Board, Corning, NY (USA). Oct 1988. 193p. Available from NTIS, PC A09/MF A01.

Six counties in New York, Allegany, Cattaraugus, Chemung, Chautauqua, Schuyler, and Steuben, took part in a study to develop a multicounty market oriented recycling program. Because of the complex picture of waste-product markets and variations of waste-management practices among the participating counties, an adaptable model was designed in which the general market and operating environment could be matched to local operational and management conditions. This approach provided each county with the ability to evaluate the recycling potential within its own jurisdiction and provided a tool to explore a regional approach for certain commodities where independent local recycling is not economically feasible. The steps for defining market alternatives are outlined.

42229 (PB–89-179972/XAB) **Population growth and development in the Chesapeake Bay watershed to the year 2020: the report of the 2020 panel to the Chesapeake Executive Council.** Environmental Protection Agency, Annapolis, MD (USA). Chesapeake Bay Program. Dec 1988. 81p. Available from NTIS, PC A05/MF A01.

Analyzes the environmental effects of population growth upon the Bay and recommends a series of actions to concentrate development in suitable areas, protect sensitive areas, direct growth to existing population centers in rural areas and protect resource areas, establish stewardship policies, conserve resources, and establish development and conservation trust funds.

42230 (PB–89-179980/XAB) **Chesapeake Bay watershed development policies and guidelines: an agreement commitment report from the Chesapeake Executive Council. Final report.** Environmental Protection Agency, Annapolis, MD (USA). Chesapeake Bay Program. Jan 1989. 37p. Available from NTIS, PC A03/MF A01.

Policies and guidelines intended to guide the location, design, construction, operation, and maintenance of new developments in such a manner as to preserve the quality of the Chesapeake Bay and its tributaries.

42231 (PB–89-180830/XAB) **Community relations in Superfund: a handbook (interim version).** Musgrave, V. ICF, Inc., Fairfax, VA (USA). Jun 1988. 190p. Available from NTIS, PC A09/MF A01.

See also PB–84-209378.

The purpose of the handbook is to provide (1) policy requirements for coordinating community regulations activities at Superfund sites, and (2) additional techniques and guidance that can be used to supplement and enhance the basic requirements for community relations. As such, the present handbook is a thorough revision of an interim version issued in September 1983. New material has been added, and existing material has been rewritten to incorporate new public participation requirements of SARA, and EPA policies issued since 1983. The overall aim has been to reflect additional years of experience in conducting community-relations activities at Superfund sites throughout the nation. While this experience has confirmed the value of the Superfund community relations program, it also has provided considerable insight, often based on trial-and-error, about which approaches and activities are more useful, and which may be less so.

42232 (PB–89-182687/XAB) **Preliminary evaluation of initial TSCA (Toxic Substances Control Act) section 8(e) substantial risk notices. January 1, 1987 to December 31, 1988.** Environmental Protection Agency, Washington, DC (USA). Office of Pesticides and Toxic Substances. Mar 1989. 589p. (EPA–560/2-89/001). Available from NTIS, PC A25/MF A01.

See also PB–87-176004.

This volume contains, in ascending submission number order, 'status reports' (i.e., preliminary evaluations) prepared by the staff of the Office of Toxic Substances in EPA's Office of Pesticides and Toxic Substances for initial submissions received by EPA from chemical manufacturers, importers, processors and distributors from January 1, 1987 to December 31, 1988 under Section 8(e), the 'substantial risk' information reporting provision of the Toxic Substances Control Act (TSCA). The status reports contained in the

compendium reflect only the initial phase of the Agency's evaluation process for the submitted information.

42233 (PB–89-186068/XAB) **Toxic Release Inventory (TRI), 1987. Data file.** Nowak, G.D.; Merrick, E. Environmental Protection Agency, Washington, DC (USA). Office of Toxic Substances. 1987. mag ta Available from NTISCP T10.

See also PB–89-158653. Source tape is in the ASCII character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB–89-186076.

Section 313 of the Emergency Planning and Community Right-to-Know Act (also known as Title III) of the Superfund Amendments and Reauthorization Act of 1986 (Public Law 99-499) requires EPA to establish a National Inventory of toxic chemical emissions from certain facilities. The reporting requirement applies to owners and operators of facilities that have 10 or more full-time employees, that are in Standard Industrial Classification (SIC) codes 20 through 39 (i.e., manufacturing facilities) and that manufacture (including importing), process, or otherwise use a listed toxic chemical in excess of specified threshold quantities.

42234 (PB–89-186076/XAB) **Toxic Release Inventory (TRI), 1987 documentation.** Environmental Protection Agency, Washington, DC (USA). Office of Toxic Substances. 1987. 73p. Available from NTIS, PC A04/MF A01.

For system on magnetic tape, see PB89-186068.\[Portions of this document are not fully legible.

The list of toxic chemicals subject to reporting consisted initially of chemicals listed for similar reporting purposes by the States of New Jersey and Maryland. There are over 300 chemicals and categories on these lists.

42235 (PB–89-187637/XAB) **Solid-waste dilemma: an agenda for action. Final report.** Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste. Feb 1989. 80p. (EPA–530/SW-89/019). Available from NTIS, PC A05/MF A01.

See also PB–88-251145.

This document describes the municipal solid-waste situation in the United States and presents a strategy to improve the management of wastes nationwide. The background document and appendices (which are available through NTIS), provide data on the problem and develop the arguments for alternative solutions. Major waste-stream components and other contributors are presented in the appendices along with a rationale and an approach for local officials to identify true costs of waste-management options.

2904 Natural Resources

Refer also to citation(s) 41768, 42390, 43517, 43518, 43525, 43526, 43527, 43528, 43529, 43531

42236 (ACUNS–8701) **Arctic heritage. Proceedings of a symposium.** Nelson, J.G. (ed.); Needham, R. (ed.); Norton, L. (ed.). Association of Canadian Universities for Northern Studies (ACUNS), Ottawa, ON (Canada). 1987. 668p. (CONF-8508276–: Arctic heritage, Banff (Canada), 24-28 Aug 1985; MICROLOG–87-03004). Available from Association of Canadian Universities for Northern Studies, 130 Albert Street, Ottawa, ON, CAN K1P 5G4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An international symposium was held to exchange information on the ecological, planning and managment aspects of Arctic heritage use and conservation. Papers were presented in the areas of natural processes and systems in the Arctic, land use and conservation, and national parks and other protected areas. Separate abstracts have been prepared for five papers from thes symposium.

42237 (ACUNS–8701, pp. 446-469) **Coastal and marine area management in the Arctic.** Mitchell, J.K. Association of Canadian Universities for Northern Studies (ACUNS), Ottawa, ON (Canada). 1987. (CONF-8508276–: Arctic heritage, Banff (Canada), 24-28 Aug 1985; MICROLOG–87-03004). In *Arctic heritage. Proceedings of a symposium.* Available from Association of Canadian Universities for Northern Studies, 130 Albert Street, Ottawa, ON, CAN K1P 5G4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Coastal and marine areas in the Arctic have long been disproportionately important, as they are associated with settlements, ports, mines, oil wells, and associated infrastructure. Ideally, public policies should recognize the integrity of the interacting coastal-marine natural system and strive to create integrated managment programs that can resolve conflicts among competing users, and reduce or eliminate negative social and environmental impacts. Using the Alaska North Slope and the Canadian Arctic as examples, this paper reviews problems of coastal and marine management and suggests direction for improving related public policies. In Alaska, a North Slope coastal management zone has been proposed whose management principle rests on protection of renewable resources. Human activities, such as oil and gas development, that affect such resources are subject to regulation. However, marine area management is done separately by a patchwork of agencies, some concerned with resouce exploitation and some with conservation. The differences with Canada are described in the areas of constitutional frameworks, native land claims, relative strengths of conservation and development interest groups, and degree of integration of coastal and marine components of management programs. Canada prefers to set coastal and marine issues within broader agency responsibilities, to base policy on loose advisory relationships among agencies, and to give Cabinet ministers paramount authority in decision making. Overall, regional and national programs for managing Arctic coastal and marine areas are uneven, often piecemeal, and fall well short of optimal performance. 47 refs., 1 fig.

42238 (DOE/PE–0088, pp. 11, Paper 15) **Senegal River Basin development program: a retrospective assessment.** Stagliano, V. USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC (USA). Office of Policy Integration. Dec 1988. In *1988 selected papers and presentations by DOE's Policy Integration Office staff.* Order Number DE89004611/JAW. Available from NTIS, PC A08/MF A01.

The Presidents of the countries of Senegal, Mali and Mauritania agreed in 1972 to reactivate dormant cooperative agreements to develop the Senegal River Basin (SRB), whose drainage area spills across the frontiers of the three nations. The three Heads of State established the organization Pour La Mise En Valeur DU Fleuve Senegal, the Senegal River Authority or OMVS as it is commonly known. The treaty of cooperation among the three riparian states accords international waterway status to the river, establishes three permanent legal bodies which are collectively known as the OMVS but are distinct in decision making. The OMVS was mandated to conduct feasibility studies for a first-phase development program comprising: a hydroelectric and water impoundment high dam at Manantali (Mali), a salt water obstruction dam at Diama (Senegal), two terminal ports at St. Louis (Senegal) and Kayes (Mali), seven river ports between the two terminals, and a permanently navigable river channel. The US involvement in the program is discussed in one section. Other sections are devoted to: the political framework; sub-projects and associated issues; the agricultural program; and issues to consider.

42239 (PB–89-192686/XAB) **How effective are federal programs in mitigating wetland losses. Technical report.** Soule, A. Arizona Univ., Tucson, AZ (USA). Dept. of Hydrology and Water Resources. 18 Dec 1988. 76p. Available from NTIS, PC A05/MF A01.

This project tests the hypothesis that fundamental value differences among three key contributors to wetlands mitigation may be important and generally unrecognized factors determining the project outcomes. The categories are: technical planners and designers of wetland mitigation projects; regulatory staffs which review mitigation projects proposals; and those who actually execute mitigation projects on site. A series of surveys are designed and reviewed to invite professionals within each group to respond to questions designed to explore potential differences in values between the three groups. The survey asks for expressions of the relative importance of factors potentially affecting project outcomes

and seeks information on factual experience with regard to the weight given to certain objectives and criteria in wetlands-mitigation planning. It is assumed that differing values will emerge as indicators of success in project planning, as will differing opinions about factors actually receiving consideration in project execution.

42240 (PB–89-862197/XAB) **Mineralogical exploration indicators. January 1970-May 1989 (Citations from the COMPENDEX data base). Report for January 1970-May 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 115p. Available from NTISPC N01/MF N01.

This bibliography contains citations concerning the utilization of physical anomalies, chemical and mineral haloes, zones, and distributions, and plant analyses to indicate the location of oil, gas, and mineral deposits. Indicators such as iron-rich minerals associated with tin deposits, mercury and radon pathfinder elements for uranium, helium in soil indicating gas deposits, molybdenum associated with copper deposits, sulfides associated with regional thermal events, plant material accumulating elements associated with nearby ore deposits, and distribution patterns of elements or minerals characteristically associated with ore deposits are discussed. Stream deposits of pathfinder elements are included. (Contains 253 citations fully indexed and including a title list.)

42241 (PB–89-862650/XAB) **Natural reserve areas: ecology and preservation. January 1970-May 1989 (Citations from the NTIS data base). Report for January 1970-May 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 58p. Available from NTISPC N01/MF N01.

This bibliography contains citations concerning natural reserve areas, primarily in the United States. Individual reserve areas are described both physically and biologically. Research associated with natural reserves is also discussed. Resource inventories, management planning, ecological assessments, monitoring programs, and designated research for the Federal Research Natural Area System are discussed. Some natural reserve areas associated with federal properties are also included. (Contains 106 citations fully indexed and including a title list.)

2905 Research, Development, Demonstration, and Commercialization

Refer also to citation(s) 41418, 42202, 42217, 42246, 42260, 42269, 42353, 43343, 43356

42242 (LBL-PUB–5208) **Program development fund: FY 1987.** Lawrence Berkeley Lab., CA (USA). Mar 1989. 70p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89015332/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

It is the objective of the Fund to encourage innovative research to maintain the Laboratory's position at the forefront of science. Funds are used to explore new ideas and concepts that may potentially develop into new directions of research for the Laboratory and that are consistent with the major needs, overall goals, and mission of the Laboratory and the DOE. The types of projects eligible for support from PDF include: work in forefront areas of science and technology for the primary purpose of enriching Laboratory research and development capabilities; advanced study of new hypotheses, new experimental concepts, or innovative approaches to energy problems; experiments directed toward "proof of principle" or early determination of the utility of a new concept; and conception, design analyses, and development of experimental devices, instruments, or components. This report is a review of these research programs.

42243 (NRC–26556) **A strategy for tribology in Canada. Enhancing reliability and efficiency through the reduction of wear and friction.** National Research Council of Canada, Ottawa, ON (Canada). 1987. 149p. (MICROLOG–87-05972). Available from National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, ON, CAN K1A 0R6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Estimates were derived in a survey of Canadian agriculture, electric utilities, forest products, mining, and transportation, indicating that total losses due to wear and friction exceed $5 billion per year. It is also estimated that about 25% of these losses could be saved through better applications of existing technology and through research and development. This report outlines a strategy to achieve these savings through tribology research and development. Estimates are presented on possible areas for savings through tribology in the areas of energy use and repair expenditure, and estimates of friction/wear-related losses are presented for the various sectors of the Canadian economy. Data for this part of the report were collected from surveys and site visits. Some comparisons are also made with losses in other countries. Research programs in tribology are reviewed, both inside and outside Canada, and extensive recommendations are made on areas of concern and future strategies. The proposed strategy is a coordinated effort directed at the simultaneous promotion of tribology research and development in industry, collaboration between industrial and non-industrial institutions, technology transfer and information services, basic research, and education and training. Specific research areas are suggested for established Canadian industries, for which there is some basis for the estimates of losses and potential savings. 25 refs., 2 figs. 29 tabs.

2906 Nuclear Energy

Refer also to citation(s) 43318

42244 (AD-A–205443/5/XAB) **India's nuclear energy program and US policies today. revision. Final report.** Wohlstetter, R. Pan Heuristics, Marina del Ray, CA (USA). Feb 1980. 66p. Available from NTIS, PC A04/MF A01.

Contents include –From Indira to Morarji to Indira; On Desai's Vain Gandhism; Pakistan, India and the Afghanistan Crisis; Appendices - Letter to Congressman Ottinger; Licensing Requirements for Export of Heavy Water to India; Morarji Desai's Views in 1965; Prime Minister Desai's Comments on Nuclear Questions, Press Conference, January 12, 1978; and Excerpt of Address by Desai in the United Nations, June 9, 1978; Notice to Aircraft Contractors from the United States Department of State.

42245 (AD-A–206944/1/XAB) **Report to the Congress on the Strategic Defense Initiative, 1989.** Strategic Defense Initiative Organization, Washington, DC (USA). 13 Mar 1989. 355p. Available from NTIS, PC A16/MF A01.

This report summarizes the SDI legacy of President Reagan, who launched the initiative with his speech of March 23, 1983. It describes in detail that current assessment of the best program for the resolution of remain technical issues, the validation of technologies, and the demonstration of the ability to integrate them. This program of research, development and testing would, if adequately funded, support a fully informed decision by the President and Congress in the future on whether to deploy a strategic defense of the United States. Such defenses could enhance deterrence and increase stability. In an effort to reduce the overall costs of a first-phase Strategic Defense System, the DOD recently completed an intensive review of the modifications made to date toward this end. The projected cost of the first phase of a Strategic Defense system has been reduced dramatically from the earlier estimate of $115 billion to $69 billion while maintaining the capability to contribute to deterrence. The review also confirmed that SDI is proceeding in the right direction toward development of a comprehensive space and ground-based Strategic Defense System.

42246 (GAO/RCED–88-138) **Nuclear science.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. 1988. 44p. Available from US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The joint Department of Energy and Air Force small reactor project was intended to develop a prototype reactor to assess the possibility of using nuclear power to meet the secure power needs of the Air Force. The project ran for a period of 4 years and cost about $3.75 million. Despite the time and money spent, it made little progress towards it intended goal, and the Air Force decided to terminate the project in May 1987. Several problems with DOE's and the Air Force's management of the project contributed to its termination, including (1) the feasibility of using nuclear power that was

not clearly established and documented prior to the decision to proceed with the project, (2) disagreements between DOE and the Air Force that contributed to a shifting of responsibility for the project, and (4) an Air Force failure to coordinate its request for project funding with the appropriate congressional committees. The Air Force is now planning another study of energy technologies to identify a potential power source to meet its secure needs. Even today, the Air Force is unsure of the extent of its need.

42247 (INFO–0240) **Report on the public perception of risk.** Atomic Energy Control Board, Ottawa, ON (Canada). Advisory Committee on Nuclear Safety. Jul 1986. 124p. (ACNS–8). Order Number DE89635642/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

French version included as INFO–0240(F).

Noting that the public's perception of risk is real whether or not it is based on what experts call scientific fact, the report examines physchological, socio-economic, informational, and cultural factors affecting risk perception. In the case of nuclear energy it is concluded that the public has little knowledge of the many measures taken to control risks.

42248 (Juel-Conf–68) **Joint German-Indonesian seminar on R and D activities using the MPR-30.** Bilateral seminars of the International Bureau, Kernforschungsanlage Juelich GmbH. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. 847p. (CONF-8508275–: Joint German-Indonesian seminar on R and D activities using the MPR-30, Jakarta (Indonesia), 19-21 Aug 1985). Available from Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek.

In 30 presentations from both sides an overview was given in the areas of materials and fuel development, radionuclide and analytical research, neutron scattering research. The lectures presented by both sides are compiled in these proceedings with the aim of further disseminating their contents thus helping BATAN to assess the possibility of introducing those R and D activities pertinent to the country's development. (orig./HP).

42249 (Juel-Conf–69) **Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.** Bilateral seminars of the International Bureau, Kernforschungsanlage Juelich GmbH. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. 478p. (CONF-8610461–: Joint German-Indonesian seminar on public acceptance, waste management, and nuclear safety, Jakarta (Indonesia), 7-9 Oct 1986). Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

A special agreement on cooperation in the field of nuclear energy was concluded 1982 between BATAN and KFA Juelich. The aim of the seminar was to convey the experience and knowledge gained on both sides in their attempts to explain technical matters, especially those related to engineered safety to the broad public. The Indonesian and German presentation give an overview in the areas of public acceptance, waste management and nuclear safety with the aim to help BATAN to assess the possibilitiy of introducing those activities pertinent to the country's development. (DG).

42250 (Juel-Conf–69, pp. 1-6) **Public information activities in the nuclear energy program in Indonesia.** Soeprapto, S. (National Atomic Energy Agency, Jakarta (Indonesia)); Kusumo, H.; Kustiono, A.S. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct 1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

The objective of BATAN Public Acceptance Programme is to convince and persuade the public concerning BATAN programmes, in particular those which relate to nuclear power generation. The information activities will be based on the objective and the strategy taking into consideration the public strata as such that the public will gain an objective understanding concerning nuclear power programme. The efforts will be done through lectures, writing papers and publication in the mass media. (DG).

42251 (Juel-Conf–69, pp. 7-30) **Decision making in energy policies with conflicting interests.** Renn, O. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Technik und Gesellschaft). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct 1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

After the accident in Chernobyl policy making and implementation of energy decisions have become more difficult than ever. On the one hand the public reacts with fear and opposition to a possible extention of nuclear power, on the other hand the economic prosperity of a country depends on an inexpensive and non-exhaustive energy source like nuclear energy. The paper describes a concept of energy planning developed by a study group of the Nuclear Research Centre in Julich (FRG). The concept is based on the idea that in a pluralistic society different social groups should participate in the policy formulation process and that the values of the public should be incorporated in the weighting process to make choices between given options. As reference theory the basic framework of decision analysis is used. (orig./DG).

42252 (Juel-Conf–69, pp. 31-90) **The development of public opinion on nuclear technology in the Federal Republic of Germany.** Grupe, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Stabsabteilung Oeffentlichkeitsarbeit). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct 1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

The development of nuclear technology over a period of nearly fifty years is analyzed in close connection with its reputation in the German public. The picture sketches the period preceding the utilization of nuclear power, the nuclear research and nuclear technology in the startup phase, the breakthrough of nuclear technology and the steps of nuclear power towards consolidation. (DG).

42253 (Juel-Conf–69, pp. 91-109) **Problems on acceptance of nuclear energy - roots, development, and varieties in different countries.** Muench, E. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Technik und Gesellschaft). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct 1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

The social situation, the economic conditions, the resources and the political facts have to be analyzed specificly and taken into consideration by improving acceptance for new technologies and especially acceptance for nuclear energy. So it was more the intention of this report to show some deciding factors for direct activities, the elements which have to be recognized, the methods which can be used, and to show how other people, especially students, behave in industrialized and in developing countries. Without a better knowledge it can not be decided precisely which of the presented countries, Japan, the Philippines of the Latin American countries are representative for the situation in Indonesia. Therefore this presentation might be the analytical background for future actions specifically focussed on the Indonesian people which enables it to make a profit of nuclear power as a vigorous energy source for further development and for the industrialization of the country. (orig./DG).

42254 (Juel-Conf–69, pp. 110-143) **Public relations activities of the Karlsruhe Nuclear Research Center - a national research center contributes to opinion forming.** Koerting, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct

1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

At the Karlsruhe Nuclear Research Center, the Public Relations Department directly reports to the Chief Executive Officer. The head of the Public Relation Department acts as spokesman of the center in the public, which requires him to be fully informed of the work of all units and of the policy goals of the executive board. The key tools used by the Public Relations Department are KfK-Hausmitteilungen, accident information, the scientific journal KfK-Nachrichten, press releases, exhibitions, fairs, guided tours, and nuclear energy information staff. (DG).

42255 (Juel-Conf–69, pp. 144-157) **Experiences of a newspaper journalist with the official information policy of nuclear facilities.** Koppelstaetter, H. (Badische Neueste Nachrichten, Karlsruhe (Germany, F.R.)). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–:). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

One of the biggest problems for a newspaper journalist is to communicate highly specialist statements about technical matters to the reader in comprehensible form. This calls for total confidence in the information at the nuclear facility, i.e. the press spokesman. A number of impressions of experiences as a newspaper editor attempting to obtain information following an accident, i.e. the extent and background of Chernobyl, are outlined. (DG).

2907 Transport and Storage

Refer also to citation(s) 41913, 42175, 42176

42256 (ACUNS–8701, pp. 425-445) **Shipping and marine environmental protection in the Arctic. Present approaches and future options.** VanderZwaag, D.; Lamson, C. Association of Canadian Universities for Northern Studies (ACUNS), Ottawa, ON (Canada). 1987. (CONF-8508276–: Arctic heritage, Banff (Canada), 24-28 Aug 1985; MICROLOG–87-03004). In *Arctic heritage. Proceedings of a symposium.* Available from Association of Canadian Universities for Northern Studies, 130 Albert Street, Ottawa, ON, CAN K1P 5G4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The relationship between Arctic shipping and the marine environment is examined through a five part analysis. A review of present and projected shipping in Canadian Arctic waters has shown that the discovery and development of offshore hydrocarbons and land-based mineral deposits during the last decade has abruptly and unalterably changed the level and scale of shipping activity. Environmental risks are outlined in two categories: ship-environmental interactions, mainly from ice damage; and the potential of vessel traffic to adversly affect marine biological populations and species habitats. A summary of Canadian legislation and administration for managing Arctic shipping is presented, concerning two major types of controls, project assessment and control approval, and shipping management. The international legal regime applicable to the Arctic is also discussed, in view of two possibilities: that the ocean beyond the 200-mile limit could be considered as part of the high seas, where minimal requirements of international law would apply, or that the ocean could be considered an unique area not subject to traditional law of the sea but requiring a specialized legal regime. Major questions include the extent of regulatory power of coastal states to restrict vessel transits, to set up traffic management systems, and to regulate vessel design, construction, equipment, and crewing of foreign vessels. It is seen that to assure that Arctic shipping and associated major projects are compatible with the marine environment, Arctic states will have to take new directions in developing ocean law and policy both the national and international levels. 22 refs., 2 figs.

2908 Waste Heat Utilization

Refer also to citation(s) 41915

42257 (PB–89-862189/XAB) **Cogeneration: economic and technical analysis. August 1983-May 1989 (Citations from the NTIS data base). Report for August 1983-May 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 190p. Available from NTISPC N01/MF N01.

Supersedes PB–88-860309.

This bibliography contains citations concerning economic and technical analysis of cogeneration systems. Topics include electric power and steam generation, dual-purpose and fuel-cell power plants, and on-site power generation. Tower focus power plants, solar cogeneration, biomass conversion, coal liquefaction and gasification, and refuse derived fuels are discussed. Feasibility studies, performance and economic evaluation, environmental impacts, and institutional factors are included. (This updated bibliography contains 354 citations, 40 of which are new entries to the previous edition.)

2910 Conservation

Refer also to citation(s) 42274, 42303, 42313, 42314, 42318, 42333, 42334, 42335, 42336, 42337, 42396, 42419

42258 (DOE/CE–0245-2) **FEMP [Federal Energy Management Program] Update, Spring 1989.** USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Federal Energy Management Program. Spr 1989. 20p. Sponsored by U.S. DOE Conservation & Renewable Energy. Order Number DE89016623/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The FEMP Update, published quarterly by the Federal Energy Management Program (FEMP), provides information that will assist federal managers in their energy management responsibilities. The Update is distributed primarily to federal facility and energy management personnel.

42259 (DOE/PE–0088, pp. 8, Paper 9) **Energy-conservation potential: a review of eight studies.** Pirkey, D.B.; Scheer, R.M. USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC (USA). Office of Policy Integration. Dec 1988. In *1988 selected papers and presentations by DOE's Policy Integration Office staff.* Order Number DE89004611/JAW. Available from NTIS, PC A08/MF A01.

This paper describes results of research that investigated the amount of energy-conservation potential remaining in the US according to existing forecasts, addressing two major questions: (1) how much conservation potential remains in the U.S. according to existing estimates, and what is the extend of variation in the range of these estimates? (2) are the studies still valid in terms of when they were done, the projection periods covered, critical assumptions made, and methodologies employed. A third issue also addressed was consideration of a range of conservation-potential definitions, should a new study of conservation potential be undertaken. The first five studies are national in scope and cover all fuel forms. The sixth and seventh studies are region-specific and cover electricity-conservation potential only. The eighth and last study, DOE's Energy Conservation Multi-Year Plan, is the only document reviewed that includes estimates of conservation potential for technologies not yet commercially available. All of the other studies are based on technologies that were considered to be cost-effective and commercially available to consumers at the time the studies were published. 1 reference, 6 figures, 1 table.

42260 (ETDE-mf–9910845) **Effective energy use in the energy industry and general industry - main emphasis in research sponsorship including energy storage systems.** BMFT - Pressereferat. Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 30 Mar 1988. 44p. (In German). Order Number DE89910845/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01.

After a short explanation of the basic principles of the sponsorship policy of the BMFT (Federal Ministry for Research and Technology), a description is given of the background to supplementary sponsorship programmes of the Federal Government, the

EC and the federal states. The main emphases in the sponsorship of effective energy use in the energy industry and in general industry are also described, also with regard to energy storage systems. Finally a few remarks are made about programme management. In the appendix appears a list of projects which have been running since 1987 with the status as of December 31, 1987. (UA).

42261 (ETDE-mf–9911011) **First meeting of the energy consulting working committee, August 11, 1986. Proceedings.** Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Jan 1987. 103p. (In German). Order Number DE89911011/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01.

The seven papers presented at the first meeting of the energy consulting working committee are entitled: status of energy consulting services as part of Hessian energy policies; energy consulting (demands, requirements, problems); the Saarbruecken energy services - experiences reviewed; the Kassel energy center (structure and activities of an independent energy consulting institution supported by the city of Kassel); the energy shop (independent energy consulting institution for the region around Kassel); the Grebenau energy consulting project (experiences and practice); energy consulting services for towns, communities, and individuals offered by the district energy agent. Separate records are available for 7 papers. (HWJ).

42262 Five key aspects to energy efficiency in institutional buildings. Rose, P.H. (U.S. Dept. of Energy (US)). vp. of Retrofit opportunities for energy management and cogeneration. Payne, F.W. The Fairmont Press Inc., Lilburn, GA (1989).

This paper describes five elements for energy efficiency programs. They are: The motivations for establishing institutional energy programs; the types of energy audits which should be done; the technical equipment needed; the choices of financing; and means of maintaining commitment to the program.

2920 Supply, Demand, and Forecasting

Refer also to citation(s) 41597, 42330

42263 (DOE/EIA–0202(89/3Q)) **Short-term energy outlook: Quarterly projections.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. Jul 1989. 53p. Sponsored by U.S. DOE Management & Administration. Order Number DE89016393/JAW. Available from NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.

The Energy Information Administration (EIA) quarterly forecasts of short-term energy supply, demand, and prices are revised in January, April, July, and October for publication in the Short-Term Energy Outlook (Outlook). An annual supplement analyzes previous forecast errors, compares recent projections by other forecasters, and discusses current topics of the short-term energy markets (see Short- Term Energy Outlook: Annual Supplement, DOE/EIA-0202). The principal users of the Outlook are managers and energy analysts in private industry and government. The projections in this volume extend through the fourth quarter of 1990. The forecasts are produced using the Short-term Integrated Forecasting System (STIFS). The STIFS model uses two principal driving variables: a macroeconomic forecast and world oil price assumptions. Macroeconomic forecasts produced by data Resources, Inc., (DRI), are adjusted by EIA to reflect EIA assumptions about the world price of crude oil, energy product prices, and other assumptions which may affect the macroeconomic forecast. EIA's Oil Market Simulation Model is used to project world oil prices. 20 refs., 17 figs., 16 tabs.

42264 (PB–89-185334/XAB) **Household energy handbook: an interim guide and reference manual. World Bank technical paper.** Leach, G.; Gowen, M. International Bank for Reconstruction and Development, Washington, DC (USA). 1989. 225p. (In French). (World-Bank-TP–67F). Available from NTISMF A01.

See also English Version, PB–87-225306. Library of Congress catalog card no. 87-18864; Microfiche copies only. Paper copy available from World Bank, 1818 H. St., NW, Washington, DC 20433.

A standard framework for measuring and assessing technical information on the household energy sources in developing countries is needed. This handbook is intended as a first step toward creating such a framework. Chapter 1 discusses energy terms and principals underlying the energy units, definitions, and calculations presented in the following chapters. Chapter 2 describes household consumption patterns and their relationship to income, location and household use variables. Chapter 3 evaluates energy end-uses and the technologies that provide cooking, lighting, refrigeration, and space heating services. Chapter 4 examines household energy resources and supplies, focusing on traditional biomass fuels. Finally, Chapter 5 demonstrates simple assessment methods and presents case studies to illustrate how household energy data can be used in different types of assessments.

2930 Policy, Legislation, and Regulation

Refer also to citation(s) 41607, 41608, 41742, 42222, 42251, 43634

42265 (DOE/PE–0088, pp. 10, Paper 7) **Method for energy policy analysis.** McNutt, B.; Roop, J. USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC (USA). Office of Policy Integration. Dec 1988. In *1988 selected papers and presentations by DOE's Policy Integration Office staff.* Order Number DE89004611/JAW. Available from NTIS, PC A08/MF A01.

Increasingly volatile energy prices and the diverse and uncertain nature of energy end-use markets has caused the DOE Office of Policy Planning and Analysis to look for alternative analysis techniques to meet policy analysis needs. Cross-impact analysis is one possible approach to deal better with uncertainty. Extensive work has gone into improving this approach and making it easier to apply to policy analysis (including development of a PC version of the computational tool). Based on this work and experience in using cross-impact analysis, the following conclusions are drawn: (1) the technique generally is applicable to policy analysis in the energy end-use area; (2) the technique deals well with uncertainty while still providing a disciplined process in which the problem and variables of interest are defined; (3) an effective and usable computer model and computational algorithm was developed for cross-impact analysis; (4) defining the problem and developing the cross-impact matrix are as important as is actual solution of the matrix and presentation of likely scenarios; and (5) cross-impact analysis process is very labor- and resource-intensive. It should be undertaken with this clearly understood by all participants. 1 reference, 1 figure.

42266 (MEM–1987) **Supplementary information for legislative review, 1987-88 estimates.** Manitoba Dept. of Energy and Mines, Winnipeg, MB (Canada). [1989]. 57p. (MICROLOG–87-05444). Available from Dept. of Energy and Mines, Legislative Bldg., Rm. 301, Winnipeg, MB, CAN R3C 0V8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This estimates supplement provides background on the Manitoba Department of Energy and Mines operations and complements information contained in the printed main estimates. The document is organized into three parts: an overview of the budget requirements; a detailed analysis of programs including staffing and expenditure requirements; and a 5-year historical summary of human and financial resources. A summary of staff categories, the responsibilities of the Department, statutory responsibilities of the Minister, a glossary of terms, and an organizational chart are also included. 7 figs.

42267 (NEB-SS–EH-1-89) **Reasons for decision in the matter of an application under the National Energy Board Act of British Columbia Hydro and Power Authority.** National Energy Board, Ottawa, ON (Canada). 1989. 15p. (In French). (CE–02706). Available from National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, ON, CAN K1A 0E5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A public hearing, to extend British Columbia Hydro's licence EL-162 to 30 September 1990, was held in Vancouver on 6 and 7 March 1989. This report sets out the Board's reasons for decision on B.C. Hydro's application. The Board has satisfied itself that the power and energy that may be exported are surplus to reasonably foreseeable Canadian requirements and that the operation of Burrad will meet applicable federal environmental standards and quidelines, and has considered all other matters that appeared to

be relevant. Accordingly, on 28 March 1989, the Board issued to B.C. Hydro, subject to Governor in Council approval, on extension to 30 September 1990 of the continuing export of up to 2,000 MW of power and up to 6.000 GWh of energy in any consecutive 12 months period allowed under licence EL-162. 1 fig., 2 tabs.

2940 Fossil Fuels

Refer also to citation(s) 41509, 41556, 41597, 42218, 42219

42268 (PTB-W–37, pp. 113-125) **Preparation of L and M gases according to DVGW G 260.** Holschumacher, W. (BEB Erdoel und Erdgas GmbH, Hannover (Germany, F.R.)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Waerme. Jun 1988. (In German). (CONF-8712127–: 67. PTB-seminar on state and development of gas calorimetry and charging for heating gas, Braunschweig (Germany, F.R.), 10-11 Dec 1987). In *State and development of gas calorimetry and charging for heating gas. Proceedings.* Order Number DE89795859/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01.

A 3000 km long high pressure pipeline system supplies the German North and West with natural gas produced in Germany and abroad. Nearly half of all German natural gas supplies consist of so-called acid gases which may contain up to 28% of hydrogen sulphide and up to 50% of carbon dioxide. These natural gases are cleaned of the hydrogen sulphide and the excess carbon dioxide in acid gas cleaning plants. The cleaned gas is then available with H quality. It can be conditioned to L quality by mixing with nitrogen or a low calorific value gas. Data on the H/L gas distribution network and the flexibility of the use of gas supplies (matching variations of the market) are given and so is information on gas supplies (buffering) in underground stores (caverns), load distribution, safety of supply, control circuit, optimum demand from gas field and the properties of the gas (diagram: H and L gas annual variations.) (HWJ).

42269 Advanced research and technology development fossil energy materials program. Judkins, R.R. (9501970); Bradley, R.A. *Journal of Engineering for Gas Turbines and Power (USA)*, 110(4): 670-676 (Oct 1988).

The Advanced Research and Technology Development (AR and TD) Fossil Energy Materials Program is a multifaceted materials research and development program sponsored by the Office of Fossil Energy of the U.S. Department of Energy. The program is administered by the Office of Technical Coordination. In 1979, the Office of Fossil Energy assigned responsibilities for this program to the DOE Oak Ridge Operations Office (ORO) as the lead field office and Oak Ridge National Laboratory (ORNL) as the lead national laboratory. Technical activities on the program are divided into three research thrust areas: structural ceramic composites, alloy development and mechanical properties, and corrosion and erosion of alloys. In addition, assessments and technology transfer are included in a fourth thrust area. This paper provides information on the structure of the program and summarizes some of the major research activities.

2950 Hydrogen and Synthetic Fuels

Refer also to citation(s) 41807, 41808, 41809, 41849

2960 Electric Power

Refer also to citation(s) 42267, 42901

42270 (DOE/CE/27471–T1) **A statewide, least-cost plan for Rhode Island: Final report on the initial work of the Rhode Island least-cost planning committee.** XENERGY, Inc., Burlington, MA (USA). Dec 1988. 59p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG01-87CE27471. Order Number DE89016090/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report presents the initial, statewide Least-Cost Plan for Rhode Island developed by the Rhode Island Least-Cost Planning Committee (RILCPC). This initial plan focuses upon demand-side resources from the Commercial/Industrial (C/I) sectors to meet Rhode Island's power needs. The plan is unique because: the RILCPC represents the major stakeholders in Rhode Island's electric industry-electric companies, state energy policymakers and state utility regulators; a statewide approach was employed; and the effort was voluntary on the part of all participants.

42271 (DOE/CE/27471–T2) **Technology options and potential for energy savings for Rhode Island least-cost planning project: Final report.** XENERGY, Inc., Burlington, MA (USA). Oct 1988. 123p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG01-87CE27471. Order Number DE89016091/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report presents findings regarding candidate technologies for Rhode Island's statewide least-cost plan. The purposes of this report are as follows: assemble technical information of the conservation and load management technologies selected for analysis; present typical implementation costs and electricity savings; describe barriers to implementation; and calculate potential energy and demand savings from full implementation of the technology, where applicable. 4 figs., 24 tabs.

42272 (DOE/EIA–0095(88)) **Inventory of power plants in the United States 1988.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 10 Aug 1989. 299p. Sponsored by U.S. DOE Management & Administration. Order Number DE89016283/JAW. Available from NTIS, PC A14/MF A01 - GPO - OSTI; GPO Dep.

The Inventory of Power Plants in the United States is prepared annually by the Electric Power Division, Office of Coal, Nuclear, Electric and Alternate Fuels, Energy Information Administration (EIA), US Department of Energy (DOE). The purpose of this publication is to provide year-end statistics about electric generating units in operation and to provide a 10 year outlook of future generating unit additions by electric utilities in the United States (the 50 States and the District of Columbia) and Puerto Rico. Data summarized in this report are useful to a wide audience including Congress, Federal and State agencies, the electric utility industry, and the general public. The data presented in this report were assembled and published by the EIA, to fulfill its data collection and dissemination responsibilities as specified in the Federal Energy Administration Act of 1974 (Public Law 93-275) as amended.

42273 (DOE/EIA–0226(89/05)) **Electric power monthly, May 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 14 Aug 1989. 176p. Sponsored by U.S. DOE Management & Administration. Order Number DE89016281/JAW. Available from NTIS, PC A08/MF A01 - GPO - OSTI; GPO Dep.

The Electric Power Monthly (EPM) is prepared by the Electric Power Division; Office of Coal, Nuclear, Electric and Alternate Fuels; Energy Information Administration (EIA); Department of Energy. The purpose of this publication is to provide energy decisionmakers with accurate and timely information. The EPM presents monthly summaries of electric utility statistics at the national, Census division, and State level for net generation, fuel consumption, fuel stocks, quantity and quality of fuel, cost of fuel, electricity sales, and retail prices of electricity. Data on net generation are also displayed at the North American Electric Reliability Council (NERC) region level. Additionally, company and plant level information are published in the EPM on capability of new plants, net generation, fuel consumption, fuel stocks, quantity and quality of fuel, and cost of fuel. Quantity, quality, and cost of fuel data lag the net generation, fuel consumption, fuel stocks, electricity sales, and retail prices data by one month. This difference in reporting appears in the national, Census division, and State level tables. However, at the plant level, all statistics presented are for the earlier month for the purpose of comparison. 10 refs., 1 fig., 3 tabs.

42274 (DOE/PE–0088, pp. 10, Paper 4) **US policies and technology options: Least-Cost Utility Planning.** Millhone, J.; Pirkey, D. USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC (USA). Office of Policy Integration. Dec 1988. In *1988 selected papers and presentations by DOE's Policy Integration Office staff.* Order Number DE89004611/JAW. Available from NTIS, PC A08/MF A01.

After receiving limited attention throughout most of the history of utilities, the demand-side of electric-utility operations is now the focus of intense attention by utilities, regulators, and the public at large. The plans and programs produced by this attention have the potential for increased public service and more-stable and profitable utility operations. Achieving this potential will require that utilities, regulators, and others examine the new set of demand-side issues with a cooperative, problem-solving attitude that opens up new communication channels and considers the need for institutional changes and regulatory reforms. Within this context, DOE and its LCUP project are playing a supportive, catalytic role. Demand-side planning and programs can strengthen the utilities position and reduce their uncertainty. Some states and cities are now considering the least-cost concept in developing plans that integrate all energy sources and uses. 21 references, 3 figures.

42275 (DOE/PE–0088, pp. 3, Paper 10) **Least-Cost Utility Planning: a federal perspective.** Pirkey, D.B. USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC (USA). Office of Policy Integration. Dec 1988. In *1988 selected papers and presentations by DOE's Policy Integration Office staff.* Order Number DE89004611/JAW. Available from NTIS, PC A08/MF A01.

The LCUP Program's first activity was to determine what the utility industry, its regulators, and consumer and environment groups felt were the most important research needs. To implement the program, DOE is sponsoring research through selected projects and grants to fill those needs. With the information and findings from the LCUP Program and the analytic program, the Department of Energy (DOE) is attempting to develop a Federal perspective on least-cost planning. DOE hopes to reduce the uncertainty about least-cost planning and to provide guidance about the successes and problems in its implementation. They also hope to contribute information to the debate about the role of least-cost planning in meeting the future demand for electricity.

42276 (ENEL–440.100-11) **Downtime cost analysis: critical review of results obtained in various countries.** Insinga, F.; Mazzoni, M. Ente Nazionale per l'Energia Elettrica, Milan (Italy); Ente Nazionale per l'Energia Elettrica, Rome (Italy). May 1987. 13p. (In Italian). Order Number DE89761920/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Downtime costs are categorized as short and long term costs, direct and indirect costs. In the industrial sector, planned interruptions are treated separately from unexpected outages. Costs due to power interruptions are calculated as loss of production, equipment damage, shutdown and re-startup. In the domestic sector, an assessment is made of the users willingness to pay extra for guaranteed power supplies. Since there are indications that losses in the commercial sector could be substantial, it is suggested that a theoretical model and methodology be developed to allow a more accurate assessment. A critical review of analyses carried out by the utilities of various countries is provided.

42277 (EPRI-CU–6297) **Test marketing.** Electric utility market research monograph series, research project 1537. Davis, T.D.; Sabo, C. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA); New York State Electric and Gas Corp., Ithaca, NY (USA). c 1989. 145p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This paper discuses topics related to test marketing by the electric utilities including: development and implementation of marketing programs; evaluation of the programs; and planning and studies related to marketing.(JEF)

42278 (EPRI-EM–5843, pp. 3.1.1-3.1.6) **Industrial end-use planning methodology (INDEPTH).** Hamblin, D. (Battelle Columbus Labs., OH (USA)); King, M. Electric Power Research Inst., Palo Alto, CA (USA); Barakat, Howard and Chamberlin, Inc., Oakland, CA (USA). Aug 1988. (CONF-8709329–: Annual review of demand-side planning research, Houston, TX (USA), 9-11 Sep 1987). In *1987 annual review of demand-side planning research: Proceedings.* Order Number DE88016698/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Utility planners can now analyze and forecast industrial electricity consumption by using INDEPTH, an industrial end-use planning method developed by the Electric Power Research Institute (EPRI). INDEPTH is a computer modeling tool that enables utilities to develop long-term econometric forecasts of electricity use for all or selected parts of the manufacturing sector in any service area; assess the energy consumption of 10 key electricity-intensive industries; and evaluate the electricity consumption and operating performance of six types of equipment (such as motors, chillers, and furnaces) commonly used in the industrial sector. Prior to the development of INDEPTH, only time-trend or simple econometric modeling techniques were available to utilities for forecasting industrial electricity use. They could not explain how sudden changes in the environment - and associated changes in industrial equipment, technologies, or production processes - would affect industrial-sector electricity use. As a result, many utility forecasts produced with these techniques failed to provide electric utilities with accurate assessments of industrial demand. INDEPTH overcomes the shortcomings of these early industrial forecasting models. By combining econometric techniques with equipment and process models, INDEPTH estimates how changes in energy prices and industrial output will affect industrial-sector electricity sales. It also estimates how use of new equipment, technologies, and processes and implementation of utility demand-side management programs will affect sales. Information generated through use of INDEPTH can be used for industrial load shaping and for making planning decisions at the service-area level.

42279 (IREQ–7403, pp. 23) **Evolution of the load according to year, month and day on Hydro-Quebec grids.** Denault, H. (Inst. de recherche de l'Hydro-Quebec, PQ, Canada). Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). 1974. (In French). (CONF-7403113–: Stockage de l'energie, Varennes (Canada), 20 Mar 1974; CE–02476). In *Symposium. Energy storage.* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

Forecasting at the Planning Division of Hydro-Quebec aims at determining the need for new equipment; the most interesting period is from 8 to 15 years in the future. This paper discusses the historical evolution of load and various data connected to load such as the load factors, the yearly classified power curve, and the distribution of the energy output during a year according to the different months. The loads of certain days and weeks are also presented. 10 figs.

42280 (IVA–364) **Role of electricity in the energy systems of the future.** Forsberg, H.G.; Mittermaier, E. (eds.). Royal Swedish Academy of Engineering Sciences, Stockholm (Sweden). 1989. 143p. (CONF-8811244–: The role of electricity in the energy systems of the future, Stockholm (Sweden), 23 Nov 1988). Order Number DE89902444/JAW. Available from NTIS (US Sales Only), PC A07.

The report comprises the lectures held at a symposium arranged by the Royal Swedish Academy of Engineering Sciences, (IVA), in November 1988. The main purpose of the symposium was to map out the production and the use of electricity in a number of industrialized countries, today as well as in the future. Separate abstracts were prepared for 7 papers of this report.

42281 (ORNL/FTR–3295) **Rural areas electrification (Latin America), Guatemala City, Guatemala, June 4–7, 1989: Foreign trip report.** Katzman, M.T. Oak Ridge National Lab., TN (USA). [1989]. 6p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC05-84OR21400. Order Number DE89016395/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

ORNL serves the function of monitoring the Central American Rural Electrification Support Program (CARES) of US Agency for International Development (USAID), which is administered by NRECA. The results of the Demand Assessment Model, presented at the conference, were reviewed, and a paper on the use of marginal cost analysis for rural electrification was delivered for presentation by NRECA staff. Discussions on the acceptability of the model were discussed with utility representatives.

42282 (PB–89-174528/XAB) **Illinois statewide electric utility plan. Volume 2. Analysis and recommendations.** Jensen, V.; Kleemann, S.; Hendren, J.; Scott, M.; Kraft, R. Illinois Dept. of Energy and Natural Resources, Springfield, IL (USA). Strategic

Planning Section. Jan 1989. 494p. (IL/ENR/RE/SP–89/01-2). Available from NTIS, PC A21/MF A01.

See also Volume 1, PB–89-152714 and Volume 3, PB–89-174536.

Under the Illinois Public Utilities Act, the Department is required to prepare a biennial electric utility energy plan for the state. The plan, prepared in three volumes, assesses electricity demand and supply for three futures over the period 1989 - 2010. In addition, assessments of conservation, cogeneration, power purchases, and plant life extension are presented. Finally, the plan examines four key 'boundary issues'; deregulation, utility bypass, corporate and financial restructuring, and acid-rain legislation implementation. Volume I summarizes the plan's findings, Volume II contains the plan's analysis and recommendations and Volume III contains a discussion of the models and methods used to prepare the plan.

42283 (PB–89-174536/XAB) **Illinois statewide electric utility plan. Volume 3. Appendix-methodology.** Jensen, V.; Kleemann, S.; Hendren, J.; Scott, M.; Kraft, R. Illinois Dept. of Energy and Natural Resources, Springfield, IL (USA). Strategic Planning Section. Jan 1989. 629p. (IL/ENR/RE-SP–89/01-3). Available from NTIS, PC A99/MF A01.

See also Volume 2, PB–89-152714.

Under the Illinois Public Utilities Act, the Department is required to prepare a biennial electric utility energy plan for the state. The plan, prepared in three volumes, assesses electricity demand and supply for three futures over the period 1989 - 2010. In addition, assessments of conservation, cogeneration, power purchases, and plant life extension are presented. Finally, the plan examines four key 'boundary issues': deregulation, utility bypass, corporate and financial restructuring, and acid-rain legislation implementation. Volume I summarizes the plan's findings, Volume II contains the plan's analysis and recommendations, and Volume III contains a discussion of the models and methods used to prepare the plan.

42284 (PB–89-175608/XAB) **Advanced Utility Simulation Model (AUSM), version 3.0. Model-Simulation.** Capone, R.; Jones, L.G. Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab. 30 Dec 1988. mag ta Available from NTISCP T08.

Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation PB–89-161772, PB–89-166631, PB–89-101208, PB–88-204268, PB–89-118749, PB–88-204276, PB–89-126569, PB–89-151468, PB–89-161780, and PB–89-166649.

This computer program simulates the operation of all electric utility generating units in the U.S. The Advanced Utility Simulation Model (AUSM) is documented in a series of 11 reports numbered EPA-600/8-88-071, volumes A through K. The model forecasts emissions, costs of electric generation, and electric rate schedules by year and by state. Alternative emissions-control scenarios, electricity growth rates, interest rates, and other economic parameters can be inputted by the model user to study their effects on electric utility construction and compliance strategies. Software Description: The model is written in the Fortran and TSO. CLIST programming languages for implementation on an IBM 3090 computer using the MVS-XA (VS Fortran Compiler) operating system. Memory requirement is 4000K bytes.

42285 **Least cost utility planning.** Millhone, J. (Office of Buildings and Community Systems, U.S. Dept. of Energy (US)). vp. of Energy technology XVI. Government Institutes Inc., Rockville, MD (1989). (CONF-890213–: 16. annual energy technology conference, 28 Feb - 2 mar 1989).

The U.S. Congress directed the U.S. Department of Energy in 1986 to initiate a least cost utility program. The initiation of the least cost utility program grew out of the search for the idealized level playing field, that is, it represents a striving to give demand-side policies an equal status with supply-side policies in balanced utility and regulatory decisions. To determine research and analysis needs, the department in 1986 undertook a survey of 135 representatives of different stakeholders, including utility executives, state commissioners, researchers, and leaders of conservation and environmental organizations. In addition, a public hearing was held and discussions occurred with major utility and Customer organizations. Based upon the recommendations received, DOE developed a four-part program plan.

42286 **Methods for calculating the electromagnetic fields from a known source distribution.** Rubinstein, M. (9501228); Uman, M.A. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electromagnetic Compatibility (USA)*, 31(2): 183-188 (May 1989).

Two different techniques for calculating the electric and magnetic fields from a distribution of currents and charges are discussed. Both techniques have been used for calculating the fields from lightning. A simple lightning return stroke current model, consisting of a square current pulse traveling up a vertical antenna above a ground plane, is used to compare the two techniques. Analytical expressions are obtained for the fields using each technique. These expressions are shown to be numerically equivalent, but the authors are unable to prove their equivalence analytically. The fact that the expressions obtained for the fields using each of the two techniques appear to be dissimilar has caused confusion, which this paper is intended to rectify.

2980 Consumption and Utilization

Refer also to citation(s) 42215, 42273, 42276

42287 (GQ/DGE–1975) **Energy. Energy balance of Quebec (1958-1974).** Pellegrin, J.-P. Gouvernement du Quebec, PQ (Canada). Direction Generale de l'Energie. 1975. 247p. (In French). (CE–02480). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

The purpose of this report is to give an overview of energy production and consumption in Quebec, to show the relations between different forms of energy, and to improve the comparability of the numerical data. Part 1 is a summary of the report of the evolution with time of the consumption, a compares Quebec and the other Canadian provinces, and evaluates the efficiency of the energy transformation system of Quebec. Part 2 gives the yearly energy balances of Quebec from 1958 on to 1974. Parts 3 to 5 give additional information (origins of imports, prices, etc.) on petroleum, electricity and gas. Quebec appears to consume nearly one third of the electricity and the petroleum consumed in Canada, but only 9% of the coal and 5% of the natural gas; as a whole, the energy consumed in Quebec is 24% of the energy consumed in Canada, just after Ontario. 2 refs., 18 figs., 8 tabs.

2990 Unconventional Sources and Power Generation

Refer also to citation(s) 41812, 41871, 42346, 42389, 42415, 42416, 42417, 42418

30 DIRECT ENERGY CONVERSION

3001 MHD Generators

Refer also to citation(s) 43792

42288 (DOE/ID/12735–T3) **[Manage, operate, and maintain the component development and integration facility in Butte, MT: Quarterly technical progress report, April 1-June 20, 1989.** MSE, Inc., Butte, MT (USA). 1989. 18p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC07-88ID12735. Order Number DE89016203/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This quarterly technical progress report presents the tasks accomplished at the Component Development and Integration facility during the third quarter of FY89. Areas of technical progress this quarter included: coal system development; seed system development; test bay modification; channel power dissipation and distribution system development; integrated topping cycle and proof-of-concept current controls project; split coal feed system; coal-fired

precombustor; iron core magnet thermal protection system checkout; combustion carbon balance and stack gas analysis; coal-fired combustor support; 1A channels refurbishment; arc observation project; dry materials transfer system controls upgrade; Mississippi State University post-nozzle test section; test operations and results; data enhancement; data analysis and modeling; technical papers; and projected activities. 3 tabs.

3003 Thermoelectric Generators

Refer also to citation(s) 42436

42289 (PB–89-170575/XAB) **Mobile electric power technologies for the Army of the future: engines, power source, and electrical aspects.** National Research Council, Washington, DC (USA). Commission on Engineering and Technical Systems. 1988. 189p. Available from NTIS, PC A09/MF A01.

The Committee on Mobile Electric Power (MEP) Plant Technologies considered the state of the art of MEP units (usually called generator sets, a generic term including engine-generators, fuel cells, batteries and thermal-to-electric devices) in the commercial sector as well as technologies that may mature during the period from 1990 to 2015. Based on its technology assessment, coupled with a consideration of the Army fuels policy and the projected battlefield needs in the twenty-first century, the committee recommends research and development (R & D) strategies for the U.S. Army's Logistics Support Directorate at Ft. Belvoir that can lead to the fielding of cost-effective MEP units meeting Army requirements.

3004 Thermionic Converters

42290 (PB–89-864086/XAB) **Thermionic cathodes. May 1985-June 1989 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for May 1985-June 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 97p. Available from NTISPC N01/MF N01.

Supersedes PB–88-865647.

This bibliography contains citations concerning the principles, designs, types, manufacturing techniques, and performance evaluations of thermionic cathodes. Several electrode materials are evaluated for thermionic emission characteristics. Some attention is given to the life testing and reliability of various cathode types. (This updated bibliography contains 152 citations, 12 of which are new entries to the previous edition.)

3005 Fuel Cells

Refer also to citation(s) 41798, 42199, 42289

42291 (AD-A–205473/2/XAB) **Long endurance underwater power system. Quarterly report, October-December 1988.** Aquanautics Corp., Alameda, CA (USA). 28 Jan 1989. 50p. Available from NTIS, PC A03/MF A01.

The development and design of deep-sea power sources for long endurances (>1 year) and moderate power (>1 kW) are unique. The best primary battery (Li-thionyl chloride) would involve huge space and weight and the cost of such a system would be prohibitive. Fuel cells with stored gases need a pressure vessel and also quite a large volume and weight. Aquanautics is engaged in developing a power source to a very demanding design. The design would involve a completely open system eliminating the need for a pressure vessel. Aquanautics will capture oxygen from the seawater to be delivered to a fuel cell. The hydrogen generated in this design is envisioned to be from a reaction between aluminum and seawater. Such a completely open system is already available from Alupower, Inc. This provides for a much safer and more compact design than cryogenic hydrogen. Lithium or magnesium can also be used. Both are expensive and lithium is known to be potentially hazardous. Since the last report, there has been major improvement of the technological issue of carrier longevity. The previous carrier had an operational life of 3 days. At present, Aquanautics has discovered a carrier called 23SuzyP which has stable electrochemical performance for over a month. We have also received a report from Alupower which shows that H_2 (result of corrosion of aluminum) at these depths would still be available mainly as gas. This retires a technical issue of having to develop a fuel cell with dissolved hydrogen.

42292 (DOE/ER/45247–2) **[Surface chemistry of electrocatalysts]: Technical progress report.** Hubbard, A.T. Cincinnati Univ., OH (USA). 2 Mar 1989. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER45247. Order Number DE89016449/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

It is proposed to determine the identity and electrochemical reactivity of the species present at electrocatalyst surfaces after pretreatment and use in solutions of hydrocarbons. This report briefly describes the progress made on the topics of: adsorption from aqueous sulfide solutions at Pt(111), benzenethiol and related adsorbates at Pt(111) electrodes (118), influence of surface structure on adsorption and electrolysis, and quantitative of molecular layers by Auger spectroscopy. (JDL)

42293 (DOE/MC/23023–2703) **Contaminant resistant molten carbonate fuel cell: Final report, June 1986–September 1988.** Remick, R.J.; Jewulski, J.R.; Osif, T.L.; Donelson, R. Institute of Gas Technology, Chicago, IL (USA). 1988. 87p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-86MC23023. Order Number DE89000989/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report summarizes the results of a 2 year program evaluating the application of solid nickel foils as hydrogen permeable barriers to contaminants in molten carbonate fuel cells. The purpose of these foils is to prevent contaminants such as H_2S, HCl, and NH_3 which are present in coal gasifier derived fuels, from reaching the electrolyte of the fuel cell, while still allowing hydrogen to reach the anode. During the first year of the program, a parametric study was conducted using 2.5 to 7.5 μm thick nickel foils in both laboratory-scale and bench-scale fuel cell tests. Two design configurations were evaluated, one in which the foil was placed adjacent to the electrolyte matrix and one in which the foil was placed between two porous metal plaques. Work during the second year of the program addressed problems associated with the buildup of product gases between the foil barrier and the electrolyte and with the reduction of hydrogen flux that occurs when sulfur species were introduced into the fuel. A porous electrolyte was prepared for use with the foil anode configuration. Work was also performed to improve the removal of these product gases from barrier-anode configuration cells by constructing gas channels in the anode itself between the foil barrier and the electrolyte matrix. An apparatus was also assembled for measuring the hydrogen flux through a thin foil at 650°C. Various coatings were then applied to the nickel foil to determine their impact on the permeability. The second year's work culminated in two bench-scale cell tests of the barrier-anode configuration using hardware having optimum specifications for this type of cell. The performance of these cells fell short of the design point criteria set as a goal at the beginning of this project. Therefore, this work will not be continued into the next fiscal year. 8 refs., 48 figs., 18 tabs.

42294 (DOE/MC/23267–2715) **Sulfur-tolerant anode materials: Final report.** Remick, R.J.; Osif, T.L.; Lawson, M.G. Institute of Gas Technology, Chicago, IL (USA). Sep 1988. 90p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-86MC23267. Order Number DE89011669/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Results of the second year's technical effort on a program to identify and evaluate alternative anode materials for use in molten carbonate fuel cells (MCFC) operating with high levels of sulfur contaminants in the fuel are summarized. In the first year of this program, a literature survey was performed covering all materials development research relating to electrode development for molten carbonate fuel cells. A final selection of 15 candidate materials was made, and samples of 9 of these 15 materials were fabricated and tested for electrical conductivity and for stability in the molten electrolyte. An additional 5 materials were evaluated during the second year. Several water-gas shift catalysts were also evaluated for their catalytic activity and sulfur resistance under conditions prevailing in the MCFC anode. These materials were titanium carbide, cobalt metal, copper metal, copper-nickel alloy, and lithium ferrate (III).

Only the lithium ferrate (III) exhibited sulfur tolerance in that the performance of the lithium ferrate (III) cell did not change when sulfur was added to the fuel. The lithium ferrate (III) was then used to fabricate anodes for two 100 cm^2 bench-scale cells. These cells were assembled and operated on a medium-Btu simulated coal gasifier-derived fuel. Results are discussed.

42295 (PB–89-194120/XAB) **Synthesis of novel fluorinated phosphonic and phosphinic acid electrolytes for phosphoric acid fuel cells. Final report, May 1985-December 1988.** Burton, D.J. Iowa Univ., Iowa City, IA (USA). Dept. of Chemistry. Feb 1989. 30p. Available from NTIS, PC A03/MF A01.

See also PB–87-218152.

New methodology has been developed for the preparation of difluoromethylene phosponate derivatives, perfluorinated bis-phosphonates, and mixed phosphonate-sulfonates. The phosphonates were converted to the respective difluoromethylene phosphonic acids, perfluorinated bis-phosphonic acids, and a mixed fluorinated phosphonic-sulfonic acid. The acids were evaluated as a fuel cell electrolyte. The mono phosphonic acids wetted the Teflon electrode and were found to be unsuitable electrolyte candidates. The bis-phosphonic acids and the mixed phosphonic-sulfonic acid did not wet the Teflon electrode, dissolved more oxygen than phosphonic acid, exhibited excellent thermal stability, and were found to warrant additional study as fuel cell electrolytes.

42296 Update on U.S. Department of Energy's phosphoric acid fuel cell program. Mayfield, M.J. (Fuel Cells Branch, Dept. of Energy, Morgantown, WV (US)); Beyma, E.F.; Nelkin, G.A. vp. of Energy technology XVI. Government Institutes Inc., Rockville, MD (1989). (CONF-890213–: 16. annual energy technology conference, 28 Feb - 2 mar 1989).

A principal objective of the Department of Energy (DOE), Office of Fossil Energy is to improve and increase the use of U.S. coal both domestically and internationally. The DOE has supported and managed a fuel cell research and development (R and D) program since 1976. Responsibility for implementing DOE's Fuel Cell Program, which includes activities related to both fuel cells and fuel cell systems, has been assigned to the Morgantown Energy Technology Center (METC). The goal of the DOE is to develop the critical technology for high-risk subsystems and components. The objective of the program is to reduce the technical risk so that commercial fuel cell power plants that have high efficiencies, reasonable lifetimes, acceptable environmental impacts, and competitive costs are feasible.

42297 Status of molten carbonate fuel cell technology. Myles, K.M. (Electrochemical Technology Program, Argonne National Lab., Argonne, IL (US)); Krumpelt, M. vp. of Energy technology XVI. Government Institutes Inc., Rockville, MD (1989). (CONF-890213–: 16. annual energy technology conference, 28 Feb - 2 mar 1989).

The molten carbonate fuel cell (MCFC) is one of the three types of fuel cells that are being developed for the utility market. This type of fuel cell operates at a temperature of about 650^{0}C, which is considerably higher than that of phosphoric acid fuel cells but is not nearly as high as that of solid oxide fuel cells. The operating temperature of the fuel cell is important in two respects. It affects how the fuel cell system must be configured to process commercial fuels into the hydrogen that is consumed by the fuel cell and the efficiency of converting the hydrogen into electricity. At temperatures below 400-500^{0}C, hydrocarbon fuels must be transformed into hydrogen by steam reforming and shifting before they can be used. This chemical processing requires bulky ancillary equipment and uses up some fuel.

42298 Solid oxide fuel cells. Bates, J.L. (Materials Sciences Dept./Pacific Northwest Lab., Richland, WA (US)). vp. of Energy technology XVI. Government Institutes Inc., Rockville, MD (1989). (CONF-890213–: 16. annual energy technology conference, 28 Feb - 2 mar 1989).

Solid oxide fuel cells (SOFC) are the least developed of the three fuel cells discussed at this conference. However, SOFC technology is developing more rapidly than any other fuel cell technology. The major differences between SOFC and phosphoric acid fuel cells (PAFC) or molten carbonate fuel cells (MCFC) are the higher operating temperature (1000^{0}C) and the solid electrolyte. Both PFAC and MCFS use liquid electrolytes; and they operate at 200^{0}C and 650^{0}C, respectively. The SOFC uses a dense, solid electrolyte that conducts electrically by the transport of oxygen ions. The electrolyte is layered between two porous, solid electrodes and cells are joined by a solid interconnection; both the electrodes and the interconnect are electronically conducting.

42299 Corrections to kinetic measurements taken on a disk electrode. West, A.C. (9522384); Newman, J. *Journal of the Electrochemical Society (USA)*, 136(1): 139-143 (Jan 1989).

Below the limiting current, the rotating disk electrode has a nonuniform current distribution. When the nonuniformities are not explicitly accounted for, errors in values of kinetic parameters determined through measurements on a disk can result. In this analysis, valid for Tafel kinetics, correction factors are obtained as a function of the dimensionless average current density.It is assumed that ohmic corrections are made by the interruption of current. The results indicate that, under certain conditions, the errors are negligible and that the disk geometry, despite its nonuniformities, is adequate for the investigation of systems characterized by Tafel kinetics.

42300 Kinetics of fuel cell reactions at the platinum/solid polymer electrolyte interface. Paik, W.K. (9512470); Springer, T.E.; Srinivasan, S. *Journal of the Electrochemical Society (USA)*, 136(3): 644-648 (Mar 1989).

Platinum gauze electrodes coated with the proton-conducting polymer, Nafion, were investigated with respect to the kinetics of the oxygen reduction and hydrogen oxidation reactions. The coated electrodes were in contact with a Nafion membrane electrolyte. The current-potential behavior of the coated electrodes depended upon the thickness of the coating. The electrodes with thicker coatings exhibited less activation and ohmic control but encountered diffusion limitations. Those with thinner coatings showed significant ohmic control. A theoretical analysis was made for the current potential relation and the current distribution using a model of a Nafion-coated wire in contact with the membrane. The present analysis confirms the necessity of optimizing the amount of Nafion impregnation in low-Pt-loads, porous gas-diffusion electrodes, as was experimentally observed in another study in the authors' laboratory.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

Refer also to citation(s) 42259

42301 (ORNL/FTR–3345) **[Thule Air Base: Cost reduction and consolidation program, Thule AB, Greenland, 17–21 July 1989]: Foreign trip report.** Van Dyke, J. Oak Ridge National Lab., TN (USA). 31 Jul 1989. 6p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. Order Number DE89016428/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Ms. Diane Matz Butlak, Air Force Space Command, Mr. Gerald Boes, SAIC Santa Barbara, and I visited Thule AB to collect data and document proposed actions for consolidating and reducing costs of operating Thule AB. Extensive interviews with Greenland Contractor personnel responsible for developing plans to consolidate Thule indicated that existing estimates of cost savings from Base consolidation measures have excluded a significant portion of potential cost savings. The existing estimates of savings do not include some operations of the indirect benefits and overhead necessary to support Contractor operation of the Base. Also fuel savings resulting from the proposed Base Consolidation and more efficient energy facilities have been calculated using $.65 per gallon of Diesel Fuel-Arctic. This rate should be carefully examined to determine whether it reflects the real cost of delivered fuel to the Base.

3201 Buildings

Refer also to citation(s) 41495, 41602, 41867, 41868, 41869, 41879, 42179, 42180, 42181, 42182, 42189, 42193, 42262, 42264, 42271, 42356, 43029, 43033, 43035, 43345, 43346, 43400, 43401, 43402, 43403, 43404, 43417, 43450

42302 (AA–8805) **Exterior wall opening cover fittings for residential construction.** Anderson Associates Ltd., Willowdale, ON (Canada). 1988. 43p. (MICROLOG–89-00617). Available from Alberta Municipal Affairs, Jarvis Bldg., 6th Floor, 9925-107 St., Edmonton, AB, CAN T5K 2H9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Modern wood frame housing requires numerous penetrations of the exterior weather membrane for electrical outlets, light fixtures, and service connections. These penetrations cause problems in fitting the exterior cladding around these items in an attractive manner and often allow air, dirt, water, or insects to enter the wall. It is proposed to solve this problem by developing a plastic cover that could be attached to the wall sheathing around a penetration before the exterior finish is applied. This cover would provide a leakproof seal around the penetration and smooth regular surfaces against which to butt the exterior finish. This simple but elegant idea required development and testing, which is described in this report. Test results indicate that proper use of the device reduces air infiltration significantly. 1 fig.

42303 (AD-A–206456/6/XAB) **Use of life-cycle costing in the development of standards. Master's thesis.** Underwood, J.M. Naval Postgraduate School, Monterey, CA (USA). Dec 1988. 63p. Available from NTIS, PC A04/MF A01.

This thesis set out to determine how, and to what extent, life-cycle costing is used in the development of voluntary consensus standards. It explains how several organizations in the commercial sector develop voluntary standards. Among these organizations was ASHRAE, who is currently developing a standard based on life-cycle costing. Standard 90.2 Energy Efficient Design of New Low-Rise Residential Buildings prescribes the insulation values for the envelope of a building. The economic methodology was based on marginal analysis by considering an upgraded construction component and then determining the incremental energy-cost savings to the incremental modification costs over a specified life-cycle period. Questions arose concerning the economic assumptions used in developing the standard. It is recommended that an impact study be performed to evaluate the cost-estimating techniques and the basic economic assumptions.

42304 (ENEA-RT-FARE–88-09) **Methods to compare the main economic and energetic elements of some heating systems.** Guarino, D. ENEA, Casaccia (Italy). Dipt. Fonti Alternative e Risparmio Energetico. Sep 1988. 127p. (In Italian). Order Number DE89761847/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

Energy consumption of building heating systems forms an important part of total energy consumption in Italy. Energy saving programs are, therefore, very important to the national economy. The parties heavily involved in this area are the public and private operators who must plan the heating of new urban areas, or evaluate opportunities to improve existing heating systems. Part of their task consists of comparing the main economic and energetic elements between some heating systems. The usual procedure involves the taking into consideration of the following systems: - heat distribution network with combined generation of heat and electric power; - the consumer's installations fed by natural gas network; - the consumer's installations fed by oil. The analysis can be extended to other total energy heating plants employing heat-pumps, etc. Since systems which supply building heating and other energetic services differ, the economic and energetic evaluation of each system is based on total furnished services. Plans are being made to create a computer program which would allow a quicker and easier performance of this analysis.

42305 (ETDE-mf–9795588) **Boundary conditions for the existence of a heat trap in non-residential buildings and possible solutions.** Reinmuth, F. Kraftanlagen A.G., Heidelberg (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Jun 1984. 151p. (In German). Contract BMFT 03E-4475A. Order Number DE89795588/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01.

Text and appendices in two separate volumes.

By heat traps are meant buildings in the non-residential sector in which there are high internal heating loads and at the same time the outer surfaces of the buildings, especially the facade, are thermally insulated. The insulation leads to a saving in heat energy; the excessive heating in summertime requires an increased expenditure of energy for ventilation and cooling where there is air conditioning. First of all the causes of heat traps are presented. The following causes are studied using as example an office and administration building: heat insulation value of the external wall, window size or window surface proportion of the facade, type of glazing, type of air conditioning plants, strength of the artificial lighting and internal heating loads. The second part of the report deals with possible ways of avoiding a heat trap. They include temporary heat conservation in buildings, running ventilation units at night in high summer and windows or outer walls with variable U-values. (BR).

42306 (ETDE-mf–9910841) **Building and test of a combined wind energy converter/heat pump plant for heat supply for the recreational area Spadener See.** Cramer, G.; Wettlaufer, R. SMA System-, Mess- und Anlagentechnik - Regelsysteme G.m.b.H., Niestal (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Oct 1987. 19p. (In German). Contract BMFT 03E-5269B. Order Number DE89910841/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01.

The coupling of two wind energy converters with a heat pump system should be investigated in this project. The measurement results show that a sufficient energy yield can even be obtained in a region with low winds by using especially designed wind energy converters so that a considerable part of the coupling site's power demand can be supplied. The heating system for warm water supply and heating previously fired with gas was extended by two wind energy converters and a heat pump system in the frame of this research- and development project. The operation results were recorded and evaluated on the basis of a one-year measuring program, which started after the installation of the system in spring 1986. An information chart for visitors was installed in a demonstration room, which shows the function and relevant measurement results of the power supply system clearly arranged. A special coupling of wind energy converters and heat pump system was not necessary because the surplus power from wind energy is supplied to other electricity consumers. Thus both systems, wind energy converters and heat pump, can be examined independently in the frame of a general economy analysis. (orig.).

42307 (ETDE-mf–9911005) **2nd meeting of the energy consulting working committee, November 17, 1986: Thermal insulation - advanced systems made to meet present and future requirements. Proceedings.** Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Jun 1987. 103p. (In German). Order Number DE89911005/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01.

The five papers presented on 'thermal insulation - advanced systems made to meet present and future requirements' at the second meeting of the Hessian energy consulting working committee were entitled: energy conservation and elimination of health hazards; low-energy houses in Sweden and Denmark; thermal insulation and retrofitting of heating systems - financial incentives provided for by 'guidelines on the modernization of buildings in Hessia'; thermal insulation retrofitted - physico-structural aspects; energy conservation through highly insulated outer walls. System drawings, schematic sketches, tables, and diagrams facilitate access to the subjects discussed. Separate records are available for four papers. (HWJ).

42308 (ITL–8509) **Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Closing session.** Intertask Ltd., Ottawa, ON (Canada). 1985. 25p. (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00269). Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The closing session of this conference containes reports from session chairmen on their sessions, which included thermal energy

storage in aquifers, ice, ducts, and water bodies, as well as storage systems. Delegates of the newly formed Council for International Thermal Energy Storage Conferences expressed their opinions on matters relevant to the development of storage technology.

42309 (ITL–8509, pp. 554-561) **Designing the most cost-effective thermal storage for cooling in new buildings.** de la Moriniere, O. (Agence Francaise pour la Maitrise de l'Energie, Paris, France). Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper presents a theoretical analysis of the most cost-effective thermal storage systems and several case histories. The cost-effectiveness of a thermal energy storage system for cooling depends on its design parameters. These design parameters include: type of storage, mode of operation, initial cost, and energy-and-power savings. Most common systems use ice banks or chilled water tanks as a cool storage. Systems using the structural mass of the building (hollowcore concrete slabs), improved, if necessary, by placing latent heat of phase change materials placed inside their cores, are very attractive but not yet widespread. The mode of operation may be full storage, partial storage or demand-limited storage systems. The selection procedure will determine both the size of the storage (in ton-hours) and the avoided chilling capacity (in tons). The initial cost of a system is represented roughly by the cost of the storage minus the cost of the avoided chilling capacity. Market forces are likely to favor partial storage systems among customers. The interest of society favors use of demand-limited storage, because it is still far less expensive to save an extra peak kW than to produce it. Utilities have to define differential inducement programs or use their rates to give the right price signal, so that full peak avoidance will become cost-effective for their customers. 6 refs., 9 figs., 5 tabs.

42310 (ITL–8509, pp. 600-604) **Experience from a lake heat system at O. Grevie, Sweden.** Svensson, T. (Chalmers Univ. of Technology, Goethemburg, Sweden). Intertask Ltd., Ottawa, ON (Canada). 1985. (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto (Canada), 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In this paper some results are summarized from a three year study of a lake heat pump system serving a residential school in southern Sweden. Heat was extracted from a small shallow lake by means of pipes 40/3.6 mm placed on or sunken about 10 cm into the soft bottom. For comparison, an earth heat pump system was also evaluated. Measurements of the energy input and output from the heat pump system as well as the temperature conditions of the lake are reported. The yearly coefficients of performance were found to be close to 2.5. Water temperatures near the bottom varied between 1 and 4^{0}C in the winter. It was shown by a heat balance calculation that the stored heat released from the bottom provides the main heat source during the winter. 3 refs., 8 figs., 1 tab.

42311 (LBL–27363) **The performance of charcoal-based radon detection under time-varying radon conditions: Experimental and theoretical results.** Sextro, R.G.; Lee, D.D. Lawrence Berkeley Lab., CA (USA). Oct 1988. 13p. Sponsored by DOE/CE;DOE/EH. DOE Contract AC03-76SF00098. (CONF-8810134–6: Symposium on radon and radon reduction technology, Denver, CO (USA), 17-21 Oct 1988). Order Number DE89015231/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Radon adsorption by charcoal is a widely used technique for measuring indoor radon concentration, particularly when short-term results are desired. There are several different devices available, ranging from permeable envelopes filled with charcoal and open-face charcoal-filled canisters to devices incorporating diffusion limiting features to reduce losses of radon due to desorption. However, the integration characteristics of these samplers are not well understood, particularly under conditions of highly varying radon concentrations. A model for predicting the response of various types of charcoal based detectors to time-variant radon concentrations has been developed; the model predictions compare well with results from chamber experiments. Both the experimental and theoretical results have also been compared with integrated continuous-sampling measurements. The implications of these comparisons for use of charcoal for screening measurements is discussed. 5 refs., 4 figs., 2 tabs.

42312 (PB–89-170476/XAB) **Microcomputer-aided design of air-conditioning systems: reference manual for program BSIMAC (Version 2.0-1987). Information document.** National Mechanical Engineering Research Inst., Pretoria (South Africa). Heat Mechanics Div. Sep 1987. 57p. (CSIR-ME–2042). Available from NTIS, PC EE06/MF E06.

See also PB–87-231890; North American Continent sales only.

This reference manual describes Version 2.0 of the air-conditioning design program BSIMAC. BSIMAC developed specifically for South African conditions and is widely used by consulting engineers and contractors involved in the design of air-conditioning systems. BSIMAC VERSION 2.0 contains a number of additions and enhancements developed partly as a result of feedback from the users of the program. The main additions include the apparatus dew-point program which calculates air quantities and coil entering-and-leaving conditions using the Carrier method, as well as the disk-drive selection program. The enhancements include additional options and simplified input and editing procedures. BSIMAC VERSION 2.0 operates with 64 kilobytes of RAM and two disk drives. The manual is a complete revision and replaces the two previous manuals so that the user of VERSION 2.0 need only consult one book.

42313 (PB–89-188619/XAB) **Thermal and economic analysis of three HVAC (heating, ventilating, and air conditioning) system types in a typical VA (Veterans Administration) patient facility.** Walton, G.N.; Petersen, S.R. National Engineering Lab. (NBS), Washington, DC (USA). Aug 1987. 59p. (NBSIR–87/3619). Available from NTIS, PC A04/MF A01.

Thermal and economic analyses were performed for three different types of heating, ventilating, and cooling systems for a patient room in a typical VA patient facility in each of four locations. Thermal analysis was done with the U.S. Army's Building Loads Analysis and System Thermodynamics (BLAST) energy analysis program. Radiant panel, variable air volume (VAV), and fan coil systems were simulated. Some subroutines were developed and added to the BLAST program in order to simulate the radiant panel system. The predicted energy requirements, energy cost projections, and system costs were then evaluated using the NBS Federal Building Life-Cycle Cost (FBLCC) program to determine the 20-year life-cycle cost of each system in each location.

42314 (PB–89-189237/XAB) **Illumination conditions and task visibility in daylit spaces.** Treado, S.J. National Inst. of Standards and Technology (NEL), Gaithersburg, MD (USA). Center for Building Technology. Mar 1989. 55p. (NISTIR–88/4014). Available from NTIS, PC A04/MF A01.

Illumination conditions are evaluated in typical building spaces based on detailed computer simulations, in order to characterize and quantify the effects of daylighting on task visibility. Examined are the effects of fenestration location and type on task contrast under daylit, electric-lit and combined conditions. The implications of the illumination conditions with daylighting on lighting and daylighting system design are discussed.

42315 (PB–89-189393/XAB) **Advanced desiccant-cooling-system development. Desiccant wheel sample performance testing. Topical report, January 1987-May 1988.** Cohen, B.; Wysk,

R.; Slosberg, R. TECOGEN, Inc., Waltham, MA (USA). Mar 1989. 171p. (TR–4315-040-89). Available from NTIS, PC A08/MF A01.

An efficient gas-fueled cooling system based on the concept of desiccant dehumidification is under development. Performance maps of the system can be generated through the use of a computer-simulation model, which predicts not only system performance but also that of the desiccant wheel. The performance of the desiccant wheel is dependent on several factors including the desiccant used, substrate material, and channel size and geometry. Each of these factors affects the ability of a desiccant to adsorb or absorb water from moist air, and then to desorb the water when the desiccant is regenerated. A laboratory facility was constructed for the purpose of testing subscale desiccant wheel samples furnished by several manufacturers. Wheel samples were exposed to a series of time-dependent dehumidifying and regeneration tests. Data from these tests were used to evaluate and compare performance from several wheel samples, including lithium chloride, silica gel, molecular sieves, and activated carbon.

42316 (PB–89-190912/XAB) **Residential furnace data base. Topical report.** Morrison, C.; Bragg, W.N. Science Applications International Corp., Chatsworth, CA (USA). Combustion Science and Advanced Technology Dept. Feb 1986. 266p. (SAIC–86/1547). Available from NTIS, PC A12/MF A01.

Results of a comprehensive measurement effort designed to characterize the combustion section of a typical residential furnace are reported. The furnace used in these tests was approved for use in the SCAQMD. Burner heads used in the appliance incorporated flame rods positioned above the fuel injection ports to control NO/NOx emissions. Results from the detailed flame traverses obtained here indicate that the flame rods do not interfere with primary fuel-conversion rates and UHC emissions are not noticeably increased. Detailed chemistry and temperature surveys were obtained throughout the flame regions. Overall system performance, temperatures and emissions were obtained during system warmup and at steady-state over a range of air shutter adjustments. It was found that the ribbon burner used in this appliance produced a typical premixed diffusion-flame profile without impinging on the combustion chamber wall. Evidence of small recirculation zones in the combustion chamber were obtained through interpretation of flame-chemistry profiles. The small recirculation regions on the edge of the flame plume do not appear to affect flame-plume aerodynamics in the furnace.

42317 (PB–89-190920/XAB) **Model and computer code for the analysis of ribbon burners with application to a residential space heater: model description and user's manual. Topical report, September 1985-June 1986.** Wu, K.T.; Edelman, R.B.; Morrison, C.Q. Science Applications International Corp., Chatsworth, CA (USA). Combustion Science and Advanced Technology Dept. Jun 1986. 95p. (SAIC–86/1749). Available from NTIS, PC A05/MF A01.

Results of a comprehensive measurement and modeling program are reported with comparisons of the model calculations to experimental data obtained from a residential space heater. Fluid dynamics, chemical kinetics, and heat-transfer processes are modeled. Applications to multiport ribbon burners operating under steady-state conditions are discussed. The generalized formulation of the model with user-specified geometries of the burner head and combustion/containment chamber allows for extension of the model to a wide range of residential and commercial appliances using ribbon burners. Model calculations include burner exhaust-product composition, thermal efficiency, detailed flame temperature, and velocity profiles. While the requirement for more detailed chemistry is indicated, the predicted chemistry profiles using only the thermally important species can be used for determination of emission sources in the flame region. This information is useful in modifying burner and combustion chamber geometries to optimize burner emissions and performance characteristics. Model inputs have been designed to reflect burner design variables such as port loading, primary aeration, and combustion chamber dimensions. These variables may be parametrically changed to determine each effect on overall burner performance.

42318 (PB–89-861710/XAB) **Energy conservation through building design. October 1984-April 1989 (Citations from the NTIS data base). Report for October 1984-April 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 117p. Available from NTISPC N01/MF N01.

Supersedes PB–88-856083.

This bibliography contains citations concerning methods and equipment utilized in the design of residential and commercial buildings to decrease energy consumption. Topics include energy conservation program descriptions and the utilization of alternative energy sources and building designs in retrofitting existing buildings and new construction. Methods of calculating and computing envelope thermal loads and payback periods are presented. (This updated bibliography contains 199 citations, 67 of which are new entries to the previous edition.)

42319 (PSA–1987) **Moisture source strength. Measurements in selected Canadian cities.** Wichenko, G.; Robinson, T. Appin Solar Associates, Inc., Winnipeg, MB (Canada). 1987. 115p. (MICROLOG–88-06480). Available from Canada Mortgage and Housing Corporation, Annex Bldg., 628 Montreal Rd., Ottawa, ON, CAN K1A 0P7; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The rates of moisture generation and removal are major factors in predicting potential moisture related problems in housing. A procedure to determine the point-in-time moisture source strength within a dwelling was field tested in 1984 on houses in Ontario and British Columbia. To broaden the base of moisture source strength data, and to further verify test procedures, moisture source strength tests were undertaken in the Canadian Prairie and Atlantic regions. A total of 35 tests were conducted in 22 houses in Regina, Winnipeg, Halifax, and St. John's, representing a range of age and type of construction. One house in each city was selected for multiple testing. It was concluded that moisture source strength testing represents a snapshot of conditions within a house, and therefore cannot provide a complete assessment of the potential for moisture problems. Multiple testing produced widely varying results, especially in older, leakier houses. Test results indicated that the quantities of moisture being processed by typical houses are often much higher than is conventionally expected. The small sample size did not allow definitive conclusions to be drawn regarding climatic or geographic differences, the distribution of moisture source strength floor by floor, or the effects of storage. In attempting to correlate moisture source strength findings with the extent of moisture problems, the consultant noted that the moisture source strength from internal sources, ground sources, and storage often equals or exceeds the moisture source strength from ventilation. It has been recommended to simplify the test procedures in order to assist in the diagnosing and retrofitting of moisture troubled units. 47 figs., 5 tabs.

42320 (SPA–3-9178) **Prototype furnace construction, phase 4. Final report.** Briggs, R.J.; Sullivan, H.F. Spider Engineering Associates (Waterloo), Inc., ON (Canada). 1985. 21p. (MICROLOG–87-05174). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This report documents a project to develop and refine protoype high efficiency condensing gas furnaces. The furnace design utilizes a unique flue gas recirculation process which enables the use of a low temperature plastic heat exchanger to cool the combustion products into the condensing temperature regime. The use of a plastic condensing heat exchanger provides a resistance to corrosion heat is superior to that typical of metals. One objective of the current work was to examine and refine the recirculation loop. The use of a single blower or double wheel blower was investigated in an effort to reduce cost, control complexity, and exhaust/recirculation interaction. The other objective was to design and construct two prototype furnaces using the refined plastic heat exchanger and the blower modifications finalized in the first part of this project. The prototype furnaces produced during this project have a steady state efficiency of 92%. The single recirculation/exhaust blower design is capable of cooling the flue gas to below 40°C. This design represents an improvement in both reliability and component costs over a previous design utilizing two blowers. The refined plastic heat exchanger design is an improvement over the original heat exchangers both in terms of seal quality and bond strength. 4 refs., 9 figs.

42321 (TU/CBS–1989) **Performance evaluation of the dynamic wall house.** Timusk, J.; Seskus, A.L.; Lio, M. Toronto Univ., ON (Canada). Centre for Building Science. [1989]. 64p. (MICROLOG–88-06481). Available from Canada Mortgage and Housing Corporation, Annex Bldg., 628 Montreal Rd., Ottawa, ON, CAN K1A 0P7; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This project demonstrates the concept and operation of a building ventilated by dynamic insulation during several winter months in central Ontario. According to this concept, air is exhausted by a fan and all fresh air is brought in through the envelope, whether through intentional or unintentional openings. Results obtained from the monitoring of temperatures, pressures, and moisture levels have shown that this dynamic wall house performed well in a cold and windy environment. Outside air needed for ventilation was induced to infiltrate slowly and uniformly across the surface of the building. The flow of incoming ventilation air was significantly prewarmed resulting in no cold drafts or cold wall surfaces. Wind had little effect on the infiltrating flow. The house also showed a drying of the exterior walls during the monitoring period. Computer simulation of seasonal heating requirements indicate that there would be energy savings for a dynamic wall house when compared to a similar conventional house. 24 figs., 8 tabs.

42322 (UBA-FB–84-138) **Present and future development in noise control of heat pumps.** Schmidt, K.P. Institut fuer Laermarme Konstruktion, Mettmann (Germany, F.R.); Umweltbundesamt, Berlin (Germany, F.R.). Nov 1984. 65p. (In German). Contract UFOPLAN-Nr. 10503704/01/02. Order Number DE89910945/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A04/MF A01.

In a first step the emission values of heat pumps sold in the German market are determined. Producers specifications show values of sound power levels from 55 up to 85 dB(A). Own measurements result in values from 66 to 84 dB(A), 21 types with filament power from 5 to 22,5 kW being examined. The second step was the construction of a low noise prototype (15 kW). A reduction of 10 dB(A) was achieved, single tones could be reduced by 15 dB. The following measures were used: acoustical optimization of the socket; isolated arrangement of all components; reduction of propagation of structure-borne noise along pipes; use of low noise compressor and fan; use of covering panels for acoustical capsule. The emission of structure-borne noise - measured at the base and the connection points to the heating system - are reduced by 10-20 dB(A). The costs due to noise reduction measures are lower than 2% of the total costs of production. (orig.) With 2 refs., 7 tabs., 27 figs.

42323 (VTT-TUTK–583) **Measurement of the bending wave power flow by the structural intensity technique.** Linjama, J.; Lahti, T. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Feb 1989. 57p. Order Number DE89902337/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

A literature survey is given on the theory of bending waves and power flow, measurement of the structural intensity, and its applications to machinery and buildings. Based on the known intensity measurement equations, a comprehensive set of frequency domain expressions is derived for bending wave intensity measurements in a beam. A practical procedure for the general 4-transducer method is developed, using the sequential 1-transducer frequency response technique. Also expressions are derived for the determination of the force- and moment-related power components separately. In a series of laboratory experiments the power carried by bending waves was measured in a simple beam, and the various developed configurations were tested and compared. The frequency response approach to detect the total power flow was shown to work well. The estimation of the force- and moment-related power components, both in the near- and the farfield, was also demonstrated.

42324 (VTT-TUTK–586) **Heat transfer to and ignition of ceiling by impinging diffusion flame.** Kokkala, M. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Feb 1989. 79p. Order Number DE89902338/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

This work is an experimental study of the heat transfer to and the ignition of a ceiling surface exposed by an impinging buoyant jet diffusion flame. Natural gas flames in the range of 2.9 kW to 10.5 kW on a burner of a diameter of 64 mm were used. The shapes of these flames are described with appropriate temperature and species concentration measurements. The gas temperature below and the total heat flux to the stagnation point were found to be functions of the ratio of the ceiling height to the flame height. In the intermittent flame region the stagnation point heat flux was found to be higher than given by You and Faeth, but to approach their results in the plume region. For these flames, the ignition of a PMMA ceiling was found to occur only if the visible flame touches the ceiling at least 50% of the time, i.e., if the average flame height is bigger than the ceiling height. The critical heat flux was between 20 kW/m^2 and 30 kW/m^2 depending, e.g., on the size of the flame. These values are higher than the critical radiative heat flux for piloted ignition of the same material. The sustained ignition of PMMA required a surface temperature in the range of 380 deg C to 410 deg C. After turning the gas burner off, the flames on the surface extinguished repeatably as the surface temperature decreased to 320 deg C.

42325 Overview of lighting research performed by the U.S. Department of Energy. Millhone, J.P. (Office of Buildings and Community Systems, U.S. Dept. of Energy (US)). vp. of Energy technology XVI. Government Institutes Inc., Rockville, MD (1989). (CONF-890213–: 16. annual energy technology conference, 28 Feb - 2 mar 1989).

Energy use in residential and commercial buildings accounts for more than 36 percent (26.6 quads) of all primary energy consumed in the United States - slightly less than industrial use (27.0 quads) and substantially more than transportation use (20.0 quads). Industrial buildings require approximately 1.3 quads for space conditioning and lighting, which is incorporated into the industrial sector's figure. Agricultural energy use is also included in the industrial sector. Lighting is second only to space conditioning (heating and air conditioning) in the consumption of energy in buildings. In commercial buildings (including institutional buildings,) lighting accounts for 25 percent of the energy consumed; in residential buildings, 7 percent.

42326 In-situ R-valves from dynamic test data. Reddy, C.S. (9512227). *Journal of Solar Energy Engineering (USA),* 111(2): 189-190 (May 1989).

To conserve energy in buildings, and properly size heating and cooling equipment, it is necessary to understand the thermal performance of building components including the walls and roofs under in-service, dynamic conditions. In-situ inspections show that performance of components in existing buildings can differ markedly from that predicted by design data analysis. This may be due to defective workmanship, faulty materials, deviation from the design specification, and/or deterioration in thermal behavior due to aging and moisture condensation. On-site testing is, therefore, needed to determine the actual thermal performance of building envelope systems. Determination of the thermal resistance of walls or roofs of buildings from in-situ measurements poses difficulties because field conditions are seldom in steady-state.

42327 Residential cooling loads and the urban heat island - the effects of albedo. Taha, Haider (Lawrence Berkeley Lab., CA (USA)); Akbari, Hashem; Rosenfeld, Arthur; Huang, Joe. *Building and Environment (UK),* 23(4): 271-283 (1988). DOE Contract AC03-76SF00098.

The urban heat island has become the target of recent research aiming at improving urban climates and energy efficiency of cities. In the warm, mid- and low-latitude cities, the typical heat island intensity averages up to 3-5^{0}C on a summer day, adding to discomfort and increasing the air-conditioning loads, whereas in some temperate and cold, high-latitude cities a 2^{0}C heat island is considered as a mild asset in winter. Some of these cities have been built to retain the urban heat. Ways to mitigate summer heat islands in hot climates, for example by increasing the urban albedo, expanding evaporative surfaces and vegetation covers, and increasing urban thermal mass are examined. From the energy consumption point of view, simple techniques such as these can be effective in reducing air-conditioning costs by modifying and improving the urban micro-and meso-climates. (author).

42328 For roughly determining the exchange of air in buildings. Feustel, H.E. (Lawrence Berkeley Lab., CA (USA)). *HLH, Heizung, Lueftung, Klimatechnik, Haustechnik (F.R. Germany)*, 40(8): 391-402 (Aug 1989). (In German). DOE Contract AC03-76SF00098.

The air flow distribution of a building, and thus both the room air load as well as the air heat losses were extremely difficult to estimate in the past without detailed simulation programmes. However, knowledge of the air distribution is especially important when considering the problem of the adequate ventilation of a building in relation to the weather conditions. In addition to a high-capacity computer, customary simulation programmes generally involve a considerable input requirement. For this reason, for over ten years, the Lawrence Berkeley Laboratory of the University of California (LBL) has also developed simplified calculating models. The manual calculation process presented here, permits the air flow distribution to be roughly estimated for all types of weather conditions and for all manner of complicated building plans. In addition, especially interesting building details can be investigated, which considerably reduces the calculation requirement even further. (orig.).

42329 Temperature transformation for high-temperature heat pumps. Rademacher, R. (3946000); Howe, L.A. *Journal of Engineering for Gas Turbines and Power (USA)*, 110(4): 652-657 (Oct 1988).

A heat pump cycle is introduced that allows heat pumping between two very high temperature levels, while the suction temperature of the working fluid vapor passing through the compressor is considerably lower. This effect of Temperature Transformation is achieved by using a working fluid mixture instead of a single pure component and by employing an unconventional cycle design. The proposed cycle allows the extension of heat pump applications to high temperature levels without encountering operating problems for conventional compressors. This cycle and its features are explained. Its performance has been calculated and the results are presented and discussed.

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Refer also to citation(s) 42396, 42419, 42595, 42596

42330 (DOE/PE–0088, pp. 19, Paper 8) **Transportation energy to the year 2020.** McNutt, B.; Greene, D.L.; Sperling, D. USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC (USA). Office of Policy Integration. Dec 1988. In *1988 selected papers and presentations by DOE's Policy Integration Office staff.* Order Number DE89004611/JAW. Available from NTIS, PC A08/MF A01.

Increasing petroleum costs and decreasing security of supplies will pose a growing challenge to transportation as we approach 2020. The US transportation sector is nearly totally dependent on petroleum today with negligible capability to use alternative energy sources. Last year, transportation alone consumed more petroleum than the US produced. The challenge can be met, however, without serious changes to the nature of the transportation system by a combination of dramatically increased energy efficiency and the beginning of a transition to alternative fuels. Air-quality improvement is likely to motivate the earliest significant markets for alternative fuels. Government policy will be important, both with respect to automobile and light-truck fuel efficiency and with respect to the conditions under which alternative and petroleum-based fuels compete in the market. 50 references, 7 figures, 5 tables.

42331 (DOE/PE–0088, pp. 5, Paper 16) **US transportation sector in perspective.** Stagliano, V. USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC (USA). Office of Policy Integration. Dec 1988. In *1988 selected papers and presentations by DOE's Policy Integration Office staff.* Order Number DE89004611/JAW. Available from NTIS, PC A08/MF A01.

The US transportation sector reflects national goals of providing maximum freedom of mobility for people, goods and services. The current system was substantially restructured by acts of Congress promulgated between 1950 and 1970. Perhaps the most influential of these were the Highway Trust Fund legislation of 1956, the Federal Aviation Administration Act of 1958 and the related Aviation Trust fund, the Aviation Deregulation Act of 1978. Policies emanating from these laws have shaped where and how Americans live, work, and pursue leisure activities. In the next decade, public policy considerations will likely focus on managing the environmental effects of auto emissions, reaching levels of auto fuel-efficiency standards that will contribute to a reduction of petroleum imports, and determining conditions for the introduction of alternative transportation fuels. The major subsectors (air, road, and rail) are discussed via background, current system size and use, and near-term transportation issues.

42332 (MU/CRT–518) **A model for the strategic planning of national freight transportation.** Crainic, T.C.; Florian, M.; Leal, J.-E. Montreal Univ., PQ (Canada). Centre de Recherche sur les Transports. 1987. 39p. (MICROLOG–87-04313). Available from Centre de recherche sur les transports, Universite@' de Montre@'al, CP 6128, Succursale A, Montre@'al, PQ, CAN H3C 3J7; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A multimode multiproduct network optimization model has been developed that is the main model of STAN, an interactive-graphic system for the strategic analysis and planning of national freight transportation systems. For STAN, a model has been developed of the rail freight transportation system, its components, operations and goals, that is compatible with both the strategic objectives of the planning system and the representation of the other transportation modes that compose a national multimode transportation system. The objective of this report is to present and analyse this strategic model of a national freight rail transportation system. It also examines how the rail model is integrated into STAN, as well as how the system may be used to model a number of realistic scenarios. 29 refs., 6 figs.

42333 (PB–89-162945/XAB) **Market-based transit-facility design. Final report.** Beimborn, E.A.; Rabinowitz, H.; Lindquist, P.S.; Opper, D.M. Wisconsin Univ., Milwaukee, WI (USA). Center for Urban Transportation. Feb 1989. 230p. Available from NTIS, PC A11/MF A01.

This document reflects the view that transit services and facilities should be designed from a market-based point of view. The report provides planning and design guidelines for transit stations, stops and terminals. Design elements are suggested that directly relate promoting the success of development activities and transit services. The report discusses general development policies and provides guidelines for the planning and design of six station types: CBD rail stations, neighborhood rail, Park-and-Ride stations, transit malls, transfer centers, and local stops. These stations are examined through four phases of planning and design: Systems planning, Site planning, Station design, and Operations/Management. Each station type is discussed in terms of location, market, connections, access, information, image, user comfort, safety and security, operations, and management.

42334 (PB–89-170237/XAB) **Urban Transportation Abstracts. Volume 6, No. 2 - Winter 1987/1988. Report for December 1987-August 1988.** Urban Mass Transportation Administration, Washington, DC (USA). Dec 1988. 253p. (UMTA-DC–06-0559-87-2). Available from NTIS, PC A12/MF A01.

See also PB–88-239884. Library of Congress catalog card no. 83-640066.

Urban Transportation Abstracts is a semiannual publication that features abstracts and research project summaries on planning, designing, financing, constructing, operating, maintaining, managing, and marketing all modes of public transit. Some of these modes are advanced guideway systems, buses, carpools, commuter services, elderly and handicapped transport, heavy rail transit, light rail transit, paratransit, rapid transit, streetcars, taxicabs, trolley buses, and vanpools. The information is selected because it is considered useful to operators, designers, researchers, planners, and government agencies at all levels.

42335 (PB–89-170351/XAB) **HRIS (Highway Research Information Service) Abstracts. Volume 20, Number 4 - Winter 1987.** National Research Council, Washington, DC (USA). Transportation Research Board. 1987. 503p. Available from NTIS, PC A22/MF A01.

See also PB–88-239892. Library of Congress catalog card no. 75-642521.

This publication provides information about highway and nonrail mass-transit research. It is compiled from computer records of the Highway Research Information Services (HRIS), an important subfile of the Transportation Research Information Services (TRIS) data base. Each issue consists of four sections: Abstracts of research reports, technical papers in conference proceedings, and journal articles, grouped by subject area; Source Index listing names and addresses of corporate authors; Author Index listing names of personal authors and coauthors of reports, papers, and articles; and Retrieval-Term Index listing subject terms from the HRIS Subject Terms List (with frequency counts), from the HRIS Thesaurus Term List and other terms useful in retrieving abstracts published in the issue.

42336 (PB–89-170377/XAB) **HRIS (Highway Research Information Service) Abstracts. Volume 21, Number 2 - Summer 1988.** National Research Council, Washington, DC (USA). Transportation Research Board. 1988. 493p. Available from NTIS, PC A21/MF A01.

See also PB–89-170369. Library of Congress catalog card no. 75-642521.

This publication provides information about highway and nonrail mass-transit research. It is compiled from computer records of the Highway Research Information Services (HRIS), an important subfile of the Transportation Research Information Services (TRIS) data base. Each issue consists of four sections: Abstracts of research reports, technical papers in conference proceedings, and journal articles, grouped by subject area; Source Index listing names and addresses of corporate authors; Author Index listing names of personal authors and coauthors of reports, papers, and articles; and Retrieval Term Index listing subject terms from the HRIS Subject Terms List (with frequency counts), from the HRIS Thesaurus Term List and other terms useful in retrieving abstracts published in the issue.

42337 (PB–89-175368/XAB) **Towards electric transportation for metropolitan areas.** Anderson, R.B.; van Wyk, J.D.N. Council for Scientific and Industrial Research, Pretoria (South Africa). 1987. 30p. Available from NTIS, PC EE05/MF E05.

North American Continent sale only.

The move towards electric transportation for cities does provide some advantages both socially and economically which might result in a happier solution given the further pressures due to dwindling energy resources of the world in general, and South Africa in particular. The growth rate of the transport and population of a few selected cities is to be portrayed based upon their performance during the last 20 years, and will be projected forward to the next twenty years. However, the conditions of viability of various electric transport systems can be set against this to indicate at what stage such systems could be seriously contemplated. Finally, a look at the possible effects of advanced technology of electric-storage systems is also considered which may have a profound effect upon the transport vehicles of the future.

42338 (PNL-SA–17177) **A beam-powered electric orbital transfer vehicle: The advantages of nuclear electric propulsion without the concerns of nuclear power.** Coomes, E.P.; Dagle, J.E. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 11p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-8907118–1: 25. American Society of Mechanical Engineers joint propulsion conference, Monterey, CA (USA), 10-13 Jul 1989). Order Number DE89015833/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The advantages of using electric propulsion systems are well-known in the aerospace community with the most common being its high specific impulse, lower propellant requirements, and lower system mass when compared to conventional chemical propulsion systems. But these advantages may not be enough to overcome the disadvantage of the added mass of the nuclear electric power source. In the past, the lack of suitable electric power systems has been a major drawback to electric propulsion. Current programs will have nuclear electric power systems available by the turn of the century. Coupling this with the resurgence of interest in free space electromagnetic transmission of energy (power beaming) and the advances in energy beam technology, a whole new approach to the use of electric propulsion for an orbital transport vehicle (OTV) is possible. Power beaming allows the on-board nuclear electric power source, the most massive component of the OTV, to be removed from the spacecraft and replaced with a lightweight energy receptor. An OTV based on power beaming could have a pay load fraction in excess of 80% and provide delivery times to geosynchronous earth orbit (GEO) as low as 120 days and require only 200 kWe. 21 refs., 10 figs., 2 tabs.

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Refer also to citation(s) 41544, 41601, 42228, 42243, 42323, 42380, 42381, 42382, 42392, 42394, 42585, 42589, 42603, 42787, 43035, 43040, 43277, 43422, 43424, 43436, 43497, 43501, 43534

42339 (AD-A–205950/9/XAB) **Pilot field-verification studies of the sodium sulfide/ferrous sulfate treatment process. Final report, September 1987-May 1988.** Wiloff, P.M.; Suciu, D.F.; Prescott, D.S.; Schober, R.K.; Loyd, F.S. EG and G Idaho, Inc., Idaho Falls, ID (USA). Sep 1988. 67p. Available from NTIS, PC A04/MF A01.

In previous project, jar and dynamic testing showed that the sodium sulfide/ferrous sulfate process was a viable method for reducing hexavalent chromium and removing heavy metals from the Tinker AFB industrial wastewater with significant decrease in sludge production and treatment costs. In this phase, pilot-plant field verification studies were conducted to evaluate the chemical and physical parameters of the chromium reduction process, the precipitation and clarification process, and the activated-sludge system. Sludge production was evaluated and compared to the sulfuric acid/sulfur dioxide/lime process.

42340 (AD-A–205977/2/XAB) **Dismantlement of Building 666 and industrial waste-water treatment plant Number 4. Final report.** Smith, D.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). Aug 1988. 106p. (EGG-HWP–8128). Available from NTIS, PC A06/MF A01.

Building 666 and Industrial Wastewater Treatment Plant No. 4, located at McClellan Air Force Base, were dismantled and disposed of as hazardous waste in accordance with applicable state and federal regulations. The facility (which was shut down in 1980) was contaminated, principally with heavy metals, and was in a deteriorated condition. This report describes work performed to dismantle the facility down to ground level and stabilize the facility floors, trenches, pits, and sumps to minimize contamination spread until future remedial actions are performed on the below-ground portions of the facility.

42341 (AD-A–206285/9/XAB) **Low-energy-consumption hydraulic techniques. Final technical report, August 1984-April 1988.** Greene, J.B.; Jeffrey, J.R.; Lohe, S.N.; Pehowski, S.E.; Pierce, N.J. McDonnell Aircraft Corp., St. Louis, MO (USA). 30 Aug 1988. 292p. Available from NTIS, PC A13/MF A01.

This report documents the efforts to develop and test low-energy-consumption hydraulic techniques. Included is a discussion of the efforts to select and analyze a baseline hydraulic system (Phase I) and conduct trade studies on various candidate design approaches which could reduce weight and power consumption (Phase II). In addition, the report discusses the development of a test plan (Phase III) and the results of an endurance test (Phase IV). This program was directed at 8000 psi hydraulic system technology using a nonflammable hydraulic fluid chlorotrifluoroethylene (CTFE) although the concepts developed could be applied to any fluid at any system pressure. The concepts selected for test were variable system pressure, flow augmentation with load recovery valves and overlapped main valves.

42342 (AD-A–207101/7/XAB) **Waste-water characterization survey, Laughlin Air Force Base, Texas. Final report.** Attebery, C.W.; Binovi, R.D. Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA). Feb 1989. 51p. (USAFOEHL–89-009EQ0105BWA). Available from NTIS, PC A04/MF A01.

A waste-water characterization survey was conducted at Laughlin AFB, Del Rio, Texas, to provide the base with analytical data for the

base National Pollutant Discharge Elimination System (NPDES) permit application. The analytical results from the waste-water survey showed excessive amounts of methylene chloride and chromium being discharged from the Corrosion Control Facility. Further, chromium and other heavy metals are accumulating in the sediment in the sewage lagoons. Effluent discharging off base contained small amounts of methylene chloride. Results of characteristics hazardous waste analyses showed the separator located outside the Corrosion Control Facility contains EP toxic hazardous waste. Recommendations: (1) Laughlin AFB should submit an industrial discharger NPDES Permit application. (2) The corrosion control facility separator should be pumped out and the contents disposed of as hazardous waste. (3) Paint stripping practices at the corrosion control facility need to be changed. (4) The sewage treatment plant should be restored to treat base effluent prior to releasing to the sewage lagoons. (5) The base should test excavated material from previous lagoon deepening projects. (6) The base should establish a routine monitoring program to sample sediments at the bottom of lagoon No. 1.

42343 (CES/MA–170) **Can pulpmill wood waste be used for land reclamation. Technical note.** Canadian Forestry Service, Fredericton, NB (Canada). Maritimes Div. 1987. 4p. (MICROLOG–87-04443). Available from Maritimes Forestry Centre, Forestry Canada, P.O. Box 4000, MacKay Dr., Fredericton, NB, CAN E3B 5P7; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Recent research has indicated that pulpmill wood waste, which is currently a disposal problem for the industry in Canada, may be an important source of organic matter for the reclamation of nonproductive forest lands. The suitability of each component of pulpmill wood waste (knots, sludge, and grit) was tested as a growing medium for black spruce seedlings in greenhouse trials. After 29 weeks, it was clear that all the waste products could support seedling growth. With routine fertilizer treatments, the height growth of seedlings in grit, sludge, or a composite of all the waste products was acceptable when compared with seedlings grown in fertilized nursery soil. Seedlings grown in fertilized knots had reduced growth. As a result of these tests, field trials were established on an unproductive log landing in New Brunswick. These trials also demonstrated that black spruce seedlings can be successfully grown in areas spread with pulpmill wood waste; however, at least during the first year, there is a shortage of available nutrients for optimum growth due to a high C:N ratio. Over time, biological activity reduces this ratio and increases nutrient availability. 1 tab.

42344 (DOE/CE/40772–7) **The production of chemicals from food processing wastes using a novel fermenter separator: Seventh quarterly report, March 1, 1989–May 31, 1989.** Dale, M.C.; Park, C.H.; Lee, W.; Havlik, S.; Lineback, D.; Okos, M.R.; Wankat, P.C. Purdue Univ., Lafayette, IN (USA). Jul 1989. 72p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG02-85CE40772. Order Number DE89015821/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Fermentation costs (which increase with higher product concentration) traditionally must be balanced against product recovery costs (which decrease with product concentration). A novel reactor-separator process has been developed at Purdue University to minimize product inhibition of fermentation rates. This has been shown to exhibit very high productivities – simultaneously producing and removing a inhibitory product while maintaining a high viable cell concentration in the reactor. The objective of this study is to develop an energy efficient and economical process to convert food wastes to usable chemicals. Work is divided into two major effects (1) an applied phase which involves design and building a whey to ethanol process as well as process design and optimization and (2) a basic phase which involves investigating alternative fermentation systems and fundamental research on immobilized cell reactor systems. Accomplishments are discussed.

42345 (DOE/CE/90027–T1) **Research on ultra low wear materials for energy conservation: Final report.** Burton, R.A.; Burton, R.G. Burton Technologies, Inc., Raleigh, NC (USA). Jun 1989. 25p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-88CE90027. Order Number DE89015317/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report summarizes a set of friction and wear measurements for glassy carbon based materials run against a broad range of counterfaces in ball on disk wear machines. The carbon based materials were operated as both riders and disks. The principal runs employed 1 N contact load, and special runs for the carbon on its own kind extended the load to 20 N. Runs were carried out in laboratory air and in dry nitrogen and argon. Wear was measured on the rider, alone. The general trend of the results showed favorably low wear coefficient for the carbon based materials. They showed much less sensitivity of the wear rate to the replacement of the air by dry nitrogen than would have been experienced by graphitic carbon.

42346 (DOE/PE–0088, pp. 11, Paper 13) **Trash to energy: a burning issue.** Podolak, P.; Fagan, M. USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC (USA). Office of Policy Integration. Dec 1988. In *1988 selected papers and presentations by DOE's Policy Integration Office staff.* Order Number DE89004611/JAW. Available from NTIS, PC A08/MF A01.

Simulating historical trends of economic factors and their affect on tonnage resulted in a forecast of nearly 26 million tons of waste-to-energy by the year 2000. This projection is smaller than the EPA estimates (done in 1986) of 32 million tons and the Governmental Advisory Associates, Inc. 1988 estimate of 44 million tons per year if all plants in the advanced planning stage are constructed. But 26 million tons is three times what was made into energy in 1984. There seems to be a change from historical patterns, resulting in a more-conservative estimate. Converting our 26, 32, and 44 million tons per year waste estimates into energy estimates gives us ranges of 2,047, 2,519, and 3,463 MW for gross power output, and 1,144, 1,409, and 1,937 MW for net power output. Using the average household electricity use of 32 million BTUs per year, the highest estimate of net power generation would be sufficient to provide electricity to 2.8 million households, or about the population of the Los Angeles - Long Beach metropolitan area. The trash can has not yet replaced the oil barrel as an energy symbol, but it's on the way. 38 footnotes, 3 figures.

42347 (EGE–8610) **Manitoba slags deposits, characterization, modifications potential utilization. Appendices.** Emery (J.) Geotechnical Engineering Ltd., Etobicoke, ON (Canada). 1986. 216p. (MICROLOG–87-02231). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

This document consists of a collection of reprinted material from various sources on the uses of slags and related research into slag properties. Most of the material relates to nonferrous slags. Areas of utilization include cement prodction, road and railway construction, sand blasting, and mine backfilling. A separate section covers the uses of steel slag. Bibliographic references and test data are provided throughout the document.

42348 (ENEA-RT-FARE–88-13) **ENEA's (Italy) activities on advanced anaerobic treatment processes.** De Poli, F.; Farina, R.; Gamboni, M.; Garuti, G.; Tilche, A. ENEA, Casaccia (Italy). Dipt. Fonti Alternative Rinnovabili e Risparmio Energetico; Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Dec 1988. 48p. Order Number DE89761956/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The anaerobic process for the treatment of organic wastes is one of the most important environmental biotechnologies. The result is energy saving, biogas production, sludge reduction and stabilization. ENEA (Italy) developed, starting from 1980, many activities in the anaerobic field, which concerned basic research, pilot plants, monitoring of real scale plants, systems and economic studies. Four examples of these activities are reported: two experiences on laboratory scale, and two real scale applications. The aim of ENEA is to apply laboratory plants to real situations, and to transform, by the use of a complete monitoring system, the real scale plants into laboratory sized ones. The four activities, whose results are shown in the paper, concern the treatment of: molasses stillage evaporator condensates (laboratory scale, SBAF and HABR reactors), distillery slops (real scale Hybrid-thermophilic SBAF reactor), distillery slops

(real scale Hybrid-mesophilic SBAF reactor), sewage water (laboratory scale UASB, ABR and AF reactors).

42349 (ENEA-RT-TIB–88-22) **Application of ABAQUS code to the simulation of simple extrusion problems.** Daneri, A.; Toselli, G. Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Dipt. Tecnologie Intersettoriali di Base. Dec 1988. 71p. Order Number DE89761942/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The capability to simulate, by computational codes, metal forming processes is very important for energy savings; indeed, up to now, the best forming processes have been established through experimental tests and many years of experience acquired in the industry. In some particular cases, for example extrusion, the calibration of forces present in the process and of the apparatus to be used to obtain a product (for example an extruded piece) of satisfactory quality, requires many tests and, consequently, substantial energy and material waste. For this reason, predicting by suitable calculations the force which must be applied to execute a forming process, the best form of a die, the forming phenomenon evolution with the corresponding distributions of stresses and plastic strains in metal worked, would allow the reduction of prime costs and times necessary to prepare the experimental apparatus. In this paper, a sensitivity study is presented concerning the structural analysis general purpose code ABAQUS and the conditions necessary to obtain the best simulation of some extrusion processes.

42350 (ENEL–430.153-6) **Specifications for sensors and transducers.** Iliceto, A. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Mar 1986. 47p. Order Number DE89761916/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The purpose of this report is to clarify the terminology used in the measurements field, with specific reference to sensors and transducers for industrial plant control systems and, at the same time, to provide a reminder of the characteristics that have to be defined when choosing such equipment. These characteristics are associated with the climatic and electromagnetic conditions of the environment in which the equipment is to be installed. Measuring requirements, also important, have to be clarified before choosing sensors and transducers. To achieve this clarification, the report suggests a rough guide in the form of a flow chart. When applied to individual cases, the chart may serve as a flow of logic for the choice of sensors and transducers to be installed in the plant. Lastly, the report deals with some more general aspects pertaining to measurements and data acquisition systems, known as "conditioning".

42351 (ETDE/CA-MS–82-17E) **Beneficiated products from fly ash. Market research.** Wilson, H.S.; Burns, J.S. Department of Energy, Mines and Resources, Ottawa, ON (Canada). Mineral Sciences Lab. 1982. 17p. (MICROLOG–87-04014). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

The need to re-evaluate Canada's mineral resources has lead to studies on utilization of by-products as source material for a variety of products. Fly ash, from coal-burning power plants, represents a possible source of fillers and additives to the oil-drilling, plastics and paint industries, a source of activated carbon for various purification problems, and a source of magnetite for heavy metal cleaning of metallurgical and thermal coals. Cenospheres, the very light component of fly ash, are becoming valuable as an ingredient of certain oil-drilling cements, insulating resins, and, in general, as a filler that is lightweight and inert. Other spherical components of fly ash, fractionated to narrow specifications are beginning to be used in the manufacture of resins and paints as a filler with high loading factor. Magnetite has been successfully removed from fly ash by both wet and dry processes and is reported to have been successfully used for heavy media washing of coal. An extensive market exists for this product. Carbon has been removed by both wet and dry processes but there is no reported currently operating process in North America. If the carbon can be shown to be activated, a large and growing market is available at a reasonably high return. A theoretical cost-benefit analysis of the fly ash fractions indicates a six to tenfold increase in the fly ash market value based on selling price. Since there are no methods of separation available for study and factors such as transportation and plant equipment are not known, it is impossible to determine the net proceeds from beneficiation. Beneficiated fly ash could replace materials currently being imported. 41 refs., 3 figs., 1 tab.

42352 (ETDE-mf–9910825) **Development of a coke-free cupola furnace. Energy conserving shaft furnace for iron materials. Final report.** Eisenwerke Dueker (F.W.) G.m.b.H. und Co. K.G., Laufach (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Jul 1986. 25p. (In German). Contract BMFT 03E-5212-A. Order Number DE89910825/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03.

Coke-fired cupola furnaces were improved and made suitable for the production of high-quality casting melts by numerous additional devices. Moreover, they were equipped with environmental protection systems with numerous dust separation devices and afterburning of CO. Thus, the shaft furnace has become a complex plant. The electric induction furnaces do not pollute the air by carbon monoxide or sulphur dioxide, but by finest and fine dust. Today, operators are forced by regulations to catch and separate these dusts. The cokeless shaft furnace with natural gas as energy carrier is characterized by its environment-friendly melting method. There is no emission of SO_2, CO and other odour nuisance by sulphur and hydrocarbon combinations and dust. Dirt and dust in flue gas are filtered out in single-stage waste gas purification. Measured values are below 15 mg/Nm^3. The losses, e.g. oxidation of C and Si in the furnace shaft are very low in the case of natural gas-fired cokeless furnaces, because the combustion can be controlled almost stoichiometrically. The cokeless shaft furnaces with natural gas as energy carrier are, compared with traditional melting methods, the most favourable ones with regard to energy management. Stockpiling is not necessary when natural gas is used. When nodular cast iron is produced, a desulphuration after the melting process is not necessary. Thus, there is also no slag, which has to be declared as special refuse in many regions. The flexibility of the plant is characterized by an adaptable melting capacity, the iron temperature nor the iron quality being changed by this. Any desired temperature adjustment is possible by combination with the superheater. Through this melting method, a melting aggregate, successful for centuries, becomes again attractive and economical. (orig.).

42353 (FRNC-TH–3473) **Technological choices and development: the energy conservation case in the Tunisian industry.** Sellami, H. Ecole Centrale des Arts et Manufactures, 92 - Chatenay-Malabry (France). 1988. 306p. (In French). Order Number DE89908208/JAW. Available from NTIS (US Sales Only), PC A14/MF A01.

The technological choices for an industrial development, especially in a developing country such as Tunisia, may be determined by two opposite principles: the appropriate technologies and the technological short cuts. The methodological approach presented here is based on a comparison of the technological choices for energy conservation in France and in Tunisia. The main energy consuming industrial sectors are analyzed for their technology use and their relative energy consumptions.

42354 (IREQ–417-U-475) **Electrical-resistance element arrays operating at high voltage for heating and drying in industrial applications.** Harbec, G.; Rodolakis, A.; Bourgeois, F.-X.; Bedard, N. Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). 1988. 66p. (CE–02631). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Electric air heaters used in industrial drying processes normally operate on a 600 V supply, but a North American market study has shown opportunities for electric heating among large energy consumers in this sector. At power levels of several MW or more, a 4.16 kV heating installation would be more economical than 600 V and, despite the possible advantages of 13.8 and 25 kV installations, could be the most attractive voltage for present-day drying processes. This is described in the first part of this report. The second part deals with the design and results of operating experience with a 1 MW, 4.16 kV, 600^{0}C prototype heating unit. The unit has

been operated in the high-voltage laboratory at the Institut de Recherches d'Hydro-Quebec without any problems other than those related to the energization of new equipment. It can therefore be concluded that the high-voltage, high-temperature heating unit developed within the scope of this project is ready for industrial application. A list of drying equipment in the industry, with their inlet air temperature, is given. 8 refs., 12 figs., 12 tabs.

42355 (NEI-FI–78) **Jet milling technique in 1990.** Kauramaeki, T.; Ylikoski, K.; Nurminen, J. Kauppa- ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. Jan 1988. 40p. (In Finnish). Order Number DE89902340/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

This work describes the effects of different things in a blast furnace slag grinding plant, which uses the FP jet milling technique. The dependence of the fineness and capacity of the product on the important variables were the fineness of the feed, geometry and number of the accelerating nozzles and the controls of the FPL remill. When preground slag was used as feed, product was about 20% finer and capacity was 60% greater compared to those values when granulated slag was fed into the grinding circuit. Changing the length of the accelerating nozzles by 50% didn't have any noticeable effect on fineness or capacity. Either there were no measurable differencies in results when two or three accelerating nozzles were used. Increasing throat diameter of the nozzles by 20% on the contrary decreased clearly fineness and capacity of the product. By decreasing the diameters of the outlet or the flushing tubes of the FPL remill one could achieve finer product and smaller capacity. When these diameters were increased product was coarser and capacity was greater.

42356 (OH/RD–87-333-K) **Industrial/commercial refrigeration. System trends and strategic conservation potential.** Pellini, F.G. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 19p. (MICROLOG–89-02617). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Energy efficiency issues in the industrial/commercial refrigeration sector were examined through a literature search and interviews of industry representatives. Emphasis was placed on energy consumption and demand reduction potential of existing and emerging technologies and equipment. Highest potential demand reductions involved the retrofitting of computerized refrigerant and defrost controls, head pressure controls, parallel, unequal compressor (rack) systems, and passive cooling systems. 28 refs.

42357 (OH/RD–88-112K) **Failure analysis of a 100-kW waste heat recovery heat pump.** Keyes, C.E. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 12p. (MICROLOG–89-02561). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The objective of this project was to determine why a particular 100 kW heat pump had such a poor service record. This report summarizes the results of the failure analysis. The conclusion was that the particular application rather than the equipment was responsible for the heat pump's poor performance. Site monitoring prior to specifying a heat pump is recommended. 1 ref., 5 figs., 1 tab.

42358 (PB–89-166763/XAB) **Removal and selective recovery of heavy-metal ions from industrial waste waters. Technical completion report.** Darnall, D.W.; Gardea-Torresdey, J. New Mexico State Univ., Las Cruces, NM (USA). New Mexico Water Resources Research Inst. Feb 1989. 98p. Available from NTIS, PC A05/MF A01.

Accumulation of toxic metal ions in water supplies is a matter of increasingly grave concern. Primarily the undesirable by-products of mining and industrial activity, these ions can cause acute and chronic illnesses in humans and other animals. In an effort to limit further contamination, development of efficient, widely applicable, low-cost methods for removal of heavy-metal ions from waters deserves high priority. One new method that has allowed both the removal and recovery of metal ions from water has been the utilization of microorganisms such as algae. This metal-ion sorption process is based upon the natural, very strong affinity of the cell walls of algae for heavy metal ions. There appear to be distinct advantages of the immobilized algal system over other technology currently used for heavy-metal-ion cleanup from waste waters. The goals of the project were (1) to examine the effects of calcium(II) and magnesium(II) on transition metal binding to the algae, (2) to test the immobilized silica-algal polymers for removal of metal ions from electroplating plant waste waters, (3) to evaluate the effects of culturing conditions on the metal binding capacity of the resulting biomass, and (4) to investigate the mechanism of metal-ion binding to different algae.

42359 (PB–89-172233/XAB) **Industrial utilization of heat exchangers for waste-heat recovery in New York State. Final report.** Caron, R.N. Little (Arthur D.), Inc., Cambridge, MA (USA). Jun 1984. 94p. Available from NTIS, PC A05/MF A01.

Waste-heat recovery has not been achieved to its fullest potential although its technology has been well-established for two decades. However, recent developments in heat-exchanger technology coupled with higher fuel costs have further increased energy-conservation possibilities and enhanced the incentive for waste-heat recovery. This report is designed to encourage use of new heat-exchanger designs by examining the heat-exchanger technologies that have the greatest opportunity for energy savings in New York State. Additionally, it describes which technologies would be most appropriate for specific industries. If New York State's industrial sector fully used this advanced heat-exchanger technology, up to 50% of heat now wasted could be recovered and used. The study indicates that heat exchangers have particular promise for the glass, chemical, paper, textile, and baking industries. Depending on the waste-heat source and intended use, the potential industrial benefit can be extensive.

42360 (PB–89-172258/XAB) **Hydride heat pump for industrial waste-heat recovery. Final report.** Turillon, P.P. ERGENICS, Wyckoff, NJ (USA). Sep 1984. 104p. Available from NTIS, PC A06/MF A01.

This report provides the results of a project to plan, design, and test a hydride heat-pump prototype that could eventually be manufactured in the United States. The principle of the hydride pump is to transfer hydrogen between two separate heat exchangers that both contain hydriding alloys. Hydriding alloys are intermetallic compounds that can absorb large quantities of hydrogen gas to form solid metal hydrides. The process can be reversed at room temperatures and modest gas pressures. It is this ability to form into metallic hydrides and then reverse that makes this type of pump so interesting. The system is closed and acts as an energy carrier between two or more beds of hydride. In this way, heat can be conveyed from one source to another without moving parts except the opening and closing of valves to control the flow. The project was successful, and was able to upgrade waste heat from a water stream in an industrial setting by 35°F, with only a minimal operating cost.

42361 (PB–89-177513/XAB) **Artificial wetlands for wastewater treatment.** Wood, A.; Rowley, M. Council for Scientific and Industrial Research, Pretoria (South Africa). National Inst. for Water Research. 1987. 7p. Available from NTIS, PC EE04/MF E04.

North American Continent sales only.

The capacity of wetlands as purification systems and nutrient sinks is well documented and extensively practiced. The potential to systematically enhance wastewater treatment efficiency through the creation of controlled artificial wetlands has been demonstrated both in Europe and the United States and is gaining increasing attention in Southern Africa. These systems offer low-cost, low technology, robust, localized, yet efficient waste-water treatment, highly appropriate to the specific needs of rural communities as well as urban and industrial applications. The paper discusses the basic concept of the artificial wetland technology and research presently being undertaken by the NIWR.

42362 (PB–89-181234/XAB) **EPA (Environmental Protection Agency) waste-minimization research program: an overview.** Bridges, J.S. Environmental Protection Agency, Cincinnati, OH

(USA). Risk Reduction Engineering Lab. 1989. 14p. (EPA–600/D-89/013). Available from NTIS, PC A03/MF A01.

The U.S. Environmental Protection Agency (EPA) has established a waste minimization research program within the Office of Research and Development's Risk Reduction Engineering Laboratory which is the primary contact for pollution-prevention research efforts concentrating on source reduction and recycling. The paper provides an overview of the Waste Minimization Branch's research programs and discusses the progress of specific projects. Through four major program areas, the Branch identifies and evaluates relevant production operations and waste management practices, demonstrates waste-reduction techniques and technologies, designs and tests prototypes of waste-management systems, performs model waste-minimization assessments for public and private pollution prevention operation, and participates in a variety of technology-transfer activities.

42363 (PB–89-181283/XAB) **Examples of biological waste-minimization technology.** Glaser, J.A. Environmental Protection Agency, Cincinnati, OH (USA). Risk Reduction Engineering Lab. Apr 1989. 10p. (EPA–600/D-89/073). Available from NTIS, PC A02/MF A01.

The use of biological means to treat waste has been a mainstay of industrial and municipal waste-water treatment technology. Recovery of waste materials or conversion to other economically useful forms of commercial products has provoked considerable scrutiny but few genuine commercial processes. This lapse of application is partially attributable to the changing knowledge base supporting such ventures and the economic recovery of development costs. The increasing cost of materials and the enforcement of environmental legislation has paved the way for a renewed interest in biological technology that offers both a recovery of unused resources and a general reduction of waste effluents.

42364 (PB–89-184626/XAB) **Guidance for conducting remedial investigations and feasibility studies under CERCLA. Interim report (Final).** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. Oct 1988. 209p. (EPA–540/G-89/004). Available from NTIS, PC A10/MF A01.

Also available from Supt. of Docs.

The remedial investigation and feasibility study (RI/FS) process represents the methodology that the Superfund program has established for characterizing the nature and extent of risks posed by uncontrolled hazardous-waste sites and for evaluating potential remedial options. The approach should be viewed as a dynamic flexible process that can and should be tailored to specific circumstances of individual sites. The objective of the RI/FS process is not the unobtainable goal of removing all uncertainty, but rather to gather information sufficient to support an informed risk-management decision regarding which remedy appears to be most appropriate for a given site. The appropriate level of analysis to meet the objective can only be reached through constant strategic thinking and careful planning concerning the essential data needed to reach a remedy selection decision.

42365 (PB–89-187645/XAB) **1985 national biennial report of hazardous-waste generators and treatment, storage, and disposal facilities regulated under RCRA (Resource Conservation and Recovery Act). Volume 1: summary.** Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste. Mar 1989. 35p. (EPA–530/SW-89/033A). Available from NTIS, PC A03/MF A01.

See also PB–89-187652.

This Summary report (Vol. I) focuses on national and regional analyses and findings. Various regional and national hazardous-waste generation and management patterns are highlighted in this volume as documented in the study's data library.

42366 (PB–89-187652/XAB) **1985 national report of hazardous-waste generators and treatment, storage and disposal facilities regulated under RCRA: (Resource Conservation and Recovery Act). Volume 2: methodology and data.** Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste. Mar 1989. 289p. (EPA–530/SW-89/033B). Available from NTIS, PC A13/MF A01.

See also PB–89-187645.

This report presents the more-extensive State data profiles upon which the national and regional results are based. It expands upon the aggregate levels analyses (explained in Vol. 1) by profiling key hazardous-waste generation and management data for all 50 States and 3 Territories. RCRA-regulated hazardous-waste generators and TSD facilities in all States, DC, Puerto Rico, and Guam completed and submitted data forms to State and EPA Regional offices describing their 1985 waste-management practices.

42367 (PB–89-188742/XAB) **Superfund Record of Decision (EPA Region 8): Broderick Wood Products Company, Adams County, Colorado, (first remedial action), June 1988.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. 30 Jun 1988. 112p. (EPA/ROD/R–08-88/021). Available from NTIS, PC A06/MF A01.

The Broderick Wood Products Company (BWP) site, is located in Adams County, Colorado, and encompasses approximately 64 acres. It is situated in a primarily industrial area. The major site includes two surface impoundments and a total of 19 buildings and structures. Between 1947 and 1981, BWP operated a wood treatment facility to treat power poles, fence posts, railroad ties, and other wood products. Records indicate that waste seepage was apparent just north of the site and became so extensive that the waste was burned off, starting in 1955. Another site inspection in December 1982 revealed the possibility of serious contamination at a trench in the vicinity of the surface impoundments that reportedly had only been used for the disposal of solid waste. The primary contaminants of concern from the impoundments affecting the soil and ground water are VOCs including benzene, organics including PAHs, PCPs, dioxins, and metals, including lead.

42368 (PB–89-189559/XAB) **Superfund Record of Decision (EPA Region 5): Mid-State Disposal Landfill, Marathon County, Wisconsin (first remedial action), September 1988. Final report.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. Sep 1988. 62p. (EPA/ROD/R–05-88/076). Available from NTIS, PC A04/MF A01.

Portions of this document are not fully legible.

The Mid-State Disposal (MSD) site is an abandoned municipal and industrial waste landfill located in central Wisconsin, in Cleveland Township, Marathon County, about 4 miles northeast of Stratford. The area has two offsite sludge-disposal lagoons owned by Weyerhaeuser, Inc. to the northeast, and private property to the south. Specific wastes received included papermill sludges, asbestos dust, solvents, pesticides, paint sludges and metals. Four areas of contamination have been identified at the site. The selected remedial action for this site includes: Installation of new soil/clay caps for the lagoon and landfills; site monitoring that includes ground water, surface water, and landfill gas monitoring; offsite ground water monitoring; provision of an alternate water supply for nearby residences; and improvement of surface water drainage.

42369 (PB–89-861629/XAB) **Recycling metal scrap. June 1970-April 1989 (Citations from the COMPENDEX data base). Report for June 1970-April 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 134p. Available from NTISPC N01/MF N01.

Supersedes PB–88-852942.

This bibliography contains citations concerning the processes, techniques, and benefits of recycling metal scrap. The recycling processes for aluminum, chromium, nickel, cobalt, lead, copper, and precious metals scrap are discussed. Recycling in the jewelry, electronics, milling, beverage, automotive, and aircraft industries are considered. Analysis of the current global scrap metal recycling trends are included. (This updated bibliography contains 341 citations, 63 of which are new entries to the previous edition.)

42370 (PB–89-861637/XAB) **Metals recovery from wastes. June 1970-April 1988 (Citations from the COMPENDEX data base). Report for June 1970-April 1988.** National Technical Information Service, Springfield, VA (USA). May 1989. 134p. Available from NTISPC N01/MF N01.

See also PB–89-861645.

This bibliography contains citations concerning the recovery and recycling or reuse of ferrous and nonferrous metals from various industrial wastes, especially waste waters. (This updated bibliography contains 334 citations, none of which are new entries to the previous edition.)

42371 (PB–89-861645/XAB) **Metals recovery from wastes. May 1988-April 1989 (Citations from the COMPENDEX data base). Report for May 1988-April 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 33p. Available from NTISPC N01/MF N01.

Supersedes PB–88-862115. See also PB–89-861637.

This bibliography contains citations concerning the recovery and recycling or reuse of ferrous and nonferrous metals from various industrial wastes, especially waste waters. (This updated bibliography contains 48 citations, all of which are new entries to the previous edition.)

42372 (PB–89-863518/XAB) **Hazardous-materials waste disposal. June 1987-May 1989 (Citations from the NTIS data base). Report for June 1987-May 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 168p. Available from NTISPC N01/MF N01.

Supersedes PB–88-864111.

This bibliography contains citations concerning the disposal of hazardous industrial and municipal wastes, chemical agents, and a variety of other dangerous substances. Topics include restoration operations, contamination abatement studies, appropriate regulation and legislation, and remedial-response strategies. Considerable attention is given to waste-disposal sites at military installations and to incineration operations. Citations pertaining specifically to radioactive waste disposal are excluded. (This updated bibliography contains 310 citations, 194 of which are new entries to the previous edition.)

42373 (PB–89-863583/XAB) **Effluent treatment in the paint and coating industry. January 1980-May 1989 (Citations from World Surface Coatings Abstracts). Report for January 1980-May 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 47p. Available from NTISPC N01/MF N01.

Supersedes PB–87-863759.

This bibliography contains citations concerning the analysis and treatment of effluents from the coating industry. Filters used for solvent absorption and recovery, activated-carbon absorption of paint fumes, hydrogen peroxide treatment of wastes, effluent heat recovery, and biological treatments are discussed. (This updated bibliography contains 101 citations, 18 of which are new entries to the previous edition.)

42374 (PB–89-863880/XAB) **Solid-waste reclamation and recycling: plastics. January 1970-May 1989 (Citations from the NTIS data base). Report for January 1970-May 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 87p. Available from NTISPC N01/MF N01.

Supersedes PB–88-861430.

This bibliography contains citations concerning the recovery of plastic wastes. Urban and industrial recycling programs are discussed. Plastics decomposition into reusable chemicals and the use of recycled plastic in new products are discussed. The economics of plastics recycling programs and participation in them are briefly included. (This updated bibliography contains 142 citations, 10 of which are new entries to the previous edition.)

42375 (PB–89-864367/XAB) **Waste treatment by reverse osmosis and membrane processes: industrial. January 1976-June 1989 (Citations from the COMPENDEX data base). Report for January 1976-June 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 125p. Available from NTISPC N01/MF N01.

Supersedes PB–88-866025.

This bibliography contains citations concerning the use of membranes to treat industrial waste water. Reverse osmosis, ion exchange, electrodialysis, and ultrafiltration processes are described. Removal of metals, sodium compounds, nitrates, flourides, dyes, and radioactive waste using membranes is examined. Wastewater treatment for chemical, pulp, textile, and steel mills using this technology is included. (This updated bibliography contains 281 citations, 35 of which are new entries to the previous edition.)

42376 (SA–8703) **Economics of natural air grain drying.** Saskatchewan Agriculture, Regina, SK (Canada). 1987. 8p. (MICROLOG–87-03044). Available from Saskatchewan Agriculture, Regina, SK, CAN S4S 0B1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The economic benefits as well as the costs of natural air grain drying (at air flows of at least 0.5 cubic feet per minute per bushel) in Saskatchewan are described. A study of eleven sizes of bins compares the annual costs and investment costs of each size of bin. Losses from overdrying are also calculated. Natural air drying has the advantages over hot air drying of low operating costs, low power consumption, and flexible labour requirements. It is seen that large diameter bins are generally least expensive on an annual cost basis. Other advantages include improved utilization efficiency of combine harvesters, increased grade lower grade loss, and reduced grain damage. 2 figs., 3 tabs.

42377 (SHA–C-258) **A comparative assessment of forest biomass conversion to energy forms. Vol. 4, Data book of unit processes for primary conversion by direct combustion.** Simons (H.A.) Ltd., Vancouver, BC (Canada). 1983. vp. (CE–02663). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This volume deals with processes that convert forest biomass into heat by direct combustion processes. Part I describes steam generating boilers erected on site to generate steam from forest biomass fuel. Part II describes combustors used for burning biomass fuels to generate hot gases for process heat. Boilers described include field erected wood-fired boilers, package wood-fired boilers, and chemical recovery boilers. Gas heaters described include suspension burners, single and multiple chamber combustors, and fluid bed combustors. The combustion process, system configuration, operating parameters, and operating costs are described for each type of steam generator and combustor. A summary of performance characteristics and a data sheet on operating characteristics on the products of individual manufacturers are also provided. 142 figs., 19 tabs.

42378 (VTT-TUTK–581) **Furnaces in the metal industry.** Laitinen, K. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Feb 1989. 102p. (In Finnish). Order Number DE89902336/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Information based on literature is presented about ceramic fibre materials and products and their physical, chemical and mechanical properties. The applicability of fibre insulation in the construction of different types of furnaces is considered. In laboratory investigations the shrinkage rates of fibre products were found to correspond well with their classification temperature. It was also found that fibrelined furnaces are much more energy effective, their heating-up time is drastically shorter and their temperature uniformity is better compared to fire-brick-lined furnaces. However, reducing atmospheres lower the maximum useful temperatures of fibre linings, soot can contaminate fibre linings in carburizing atmospheres, and fibre linings retard furnace purging. When durability of a fibre lining is essential, blanket strip construction is one of the best alternatives.

42379 **Variable dead time compensation and calculation of salt-acid concentration ratio improves evaporator control.** Mee, D.K. (Martin Marietta Energy Systems, Inc., Oak Ridge, Y-12 Plant, Oak Ridge, TN (US)); Asbury, W.L.; Kaiser, K.W.; Orejuela, M. vp. of Proceedings of the ISA/86 international conference and exhibit. Instrument Society of America, Research Triangle Park, NC (1986). (CONF-861039–: Instrument Society of America international conference and exhibit, 13-16 Oct 1986).

Control of the salt-to-acid concentration ratio in an evaporator has proved to be a difficult problem at the Oak Ridge Y-12 Plant. Rugged online measurement techniques had to be developed for the determination of salt and acid concentrations. A control scheme also had to be developed to cope with the large dead times present in a pilot-plant evaporator. To address the concentration measurement problem, density and conductivity measurements were

interfaced to a microcomputer which was used to calculate salt and acid concentrations. Dead times which approached the process time constant in magnitude caused a standard PI controller to produce unacceptable undershoots of 25%. To address this problem, a dead time compensation scheme utilizing a first-order process model with variable dead time was implemented in the microcomputer. Control and dead time compensation dramatically improved the performance with the virtual elimination of undershoot. This paper discusses the development of both online measurements and variable dead time compensation used in the evaporator control.

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Refer also to citation(s) 41601, 41810, 41911, 41912, 42228, 42235, 42274, 42304, 42342, 42346, 42348, 42362, 42363, 42368, 42372, 42374, 42583, 42787, 43489, 43501

42380 (AD-A–205955/8/XAB) **Development and design of sludge freezing beds.** Martel, C.J. Cold Regions Research and Engineering Lab., Hanover, NH (USA). Dec 1988. 58p. (CRREL–88-20). Available from NTIS, PC A04/MF A01.

This study develops design criteria for a new sludge dewatering unit operation called a sludge freezing bed. This bed uses natural freeze-thaw to condition the sludge. The total depth of sludge that can be frozen, thawed and dewatered by this process in a year is the main criterion needed for design. Laboratory tests assessed the dewaterability of freeze-thaw conditioned water treatment plant sludge and both anaerobically and aerobically digested wastewater sludges at various depths. Mathematical models for predicting the design depth were developed; values for the input parameters to the models were obtained from the literature or from laboratory and pilot-scale experiments. The dewaterability tests indicated that the depth of sludge that can be applied is not limited by drainability. Up to 2.0 m of each sludge drained in minutes after freeze-thaw conditioning. Except for the aerobically digested sludge, the solids content after drainage is high enough to permit mechanical removal. The physical and thermal characteristics of frozen sludge were found to be equivalent to those of ice. An analysis of the freezing and thawing models reveals that the design of a freezing bed will depend on the duration and intensity of the freezing and thawing seasons.

42381 (AD-A–206392/3/XAB) **Health and Safety Plan, Installation Restoration program, Stage 3 McClellan Air Force Base. Final report, November 1987-January 1988.** Styles, J. Radian Corp., Sacramento, CA (USA). Jan 1989. 92p. Available from NTIS, PC A05/MF A01.

This document contains the Health and Safety Plan to protect the health and safety of workers conducting currently anticipated aspects of Remedial Investigation/Feasibility Study (RI/FS) work tasks at McClellan AFB. This Health and Safety Plan is designed to ensure that all work tasks associated with the RI/FS are completed in a safe manner and in accordance to the Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations 1910.120. This plan is written based on the guidelines outlined in the Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (October 1985) prepared as a joint effort by the National Institute of Occupational Safety and Health, OSHA, the U.S. Environmental Protection Agency, and the U.S. Coast Guard and in accordance with OSHA Standards for General Industry, 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response.

42382 (AD-A–207102/5/XAB) **Waste-water characterization/hazardous-waste survey, Beale Air Force Base, California. Final report, 12-26 September 1988.** Attebery, C.W.; Zimmer, A.T.; Hedgecock, N.S. Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA). Jan 1989. 110p. (USAFOEHL–89-003EQ0013ASC). Available from NTIS, PC A06/MF A01.

A waste-water characterization hazardous-waste survey was conducted at Beale AFB by USAFOEHL/ECQ personnel to provide the base with sufficient information to address a State of California Notice of Violation concerning excessive discharges of boron and cyanide from the base sewage-treatment plant (STP). The results of the survey showed that the 9th RTS Precision Photo Lab along with other film-processing organizations were major contributors to the boron and cyanide discharge problems being experienced by the base STP. Maintenance organizations that utilize soaps and detergents that contain boron and cyanide also contributed to the problem.

42383 (AEC–87-18/RR1) **Recycling of waste in Alberta. Technical report and recommendations.** Environment Council of Alberta, Edmonton, AB (Canada). 1987. 154p. (MICROLOG–87-03587). Available from Environment Council of Alberta, 8th Floor, Weber Centre, 5555 Calgary Trail, Edmonton, AB, CAN T6H 5P9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An enquiry, including public hearings, was conducted in 1986 to examine ways of encouraging recycling of materials presently disposed of as waste in Alberta. Background reports on the current state of recycling and energy recovery from waste in the provice were also prepared. This document summarizes those hearings and reports. At present, waste management in Alberta has an ongoing public cost of at least $86 million/y; the province's recycling industry employs about 3,500 people and produces goods valued over $300 millon, in spite of numerous economic barriers. There is a substantial bias in favor of landfilling through a lack of appreciation of the full costs of landfills, and through subsidization of landfilling by many municipalities which means that there is no incentive to reduce waste production. In order to improve the situation for recycling, and to turn financial and environmental liabilities into assets, 68 recommendations are made. These address the need for a lessening of the economic differentials between recycling and landfill disposal, the development of a priority sequence for dealing with waste materials, the requirements for information and education in many parts of the economy, the desire for equitable treatment of the recycling industry relative to other industrial sectors, and market development both through increasing supplies and stimulating demand. 46 refs., 5 figs., 9 tabs.

42384 (AEC–87-18-RR2) **Recycling of waste in Alberta. Summary report and recommendations.** Environment Council of Alberta, Edmonton, AB (Canada). 1987. 24p. (MICROLOG–87-03479). Available from Environment Council of Alberta, 8th Floor, Weber Centre, 5555 Calgary Trail, Edmonton, AB, CAN T6H 5P9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A series of hearings was conducted in Alberta to investigate recycling of materials presently disposed of as waste. This report summarizes the results of those hearings and the additional information gathered from various agencies and visits to recycling projects. The current state of the recycling industry in Alberta is based on utilization of materials removed from the municipal waste stream. Management of the remainder of the wastes is through landfilling, costing about $86 million in 1984. It is seen that recycling and landfilling have been judged by two different economic criteria - recycling must pay its own way, while landfilling is paid out of municipal taxes and thus appears to be a free service. Attitudes to recycling were found to be favorable, with householders willing to segregate recyclable materials. Specific recommendations based on the knowledge gained from the hearings are presented. The core of the recommendations is the need to remove the discrepancy between public garbage collection and disposal services, and recyclable materials collection and recovery. This would include adoption of a user-pay policy for municipal waste management systems, making recycling and recovery a part of waste management policy, and development of demand for recyclable materials. 2 figs.

42385 (CONF-8710480–) **Energy efficient urban cooling technologies: Proceedings from the first national conference.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Jul 1988. 153p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. From National conference on energy efficient cooling; San Jose, CA (USA); 21-22 Oct 1987. Order Number DE89013864/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

The City of San Jose's Year Eight Energy Task Force Project is designed to foster the use of energy efficient cooling in commercial buildings by: assessing the feasibility of specific technologies at selected sites in San Jose; creating greater visibility for energy efficient cooling; and evaluating single building applications of thermal

energy storage. The major components of the project correspond to the objectives listed above. They are: San Jose Airport Expansion Cool Storage Feasibility Study; District Cooling Feasibility Study; and National Conference on Energy Efficient Cooling. A project team composed of City of San Jose staff, outside consultants, and personnel from the Lawrence Berkeley Laboratory and Pacific Gas and Electric Company was assembled to complete the project. The first two projects were conducted jointly by City of San Jose staff and outside consultants. The conference was organized by the City of San Jose staff and co-sponsored by major organizations in the energy field. Results from each component of these projects are included in these proceedings.

42386 (CONF-8802148–) **Decontamination of sewage sludge. Reports from practice.** Deutsche Veterinaermedizinische Gesellschaft e.V., Giessen (Germany, F.R.). 1988. 336p. (In German). From 2. Hohenheim seminar: decontamination of sewage sludge - reports from practice; 23-24 Feb 1988. Order Number DE89910962/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; NTIS (US Sales Only), PC A15/MF A01.

The report deals with thermal, chemical, and physical methods for sewage sludge decontamination as executed in practice. The thermal processes include pasteurization, aerobic-thermophilic sludge stabilization, and composting. Chemical processes as a rule employ lime as a disinfectant, and microwaves are made use of in physical processes. (EF).

42387 (DOE/CE/26577–T2) **Hospital chilled water loop assessment Miami District Cooling Project: [Final report].** Burns and Roe, Inc., Oradell, NJ (USA); Joseph Technology Corp., Montvale, NJ (USA). 8 Aug 1989. 238p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG01-88CE26577. Order Number DE89016117/JAW. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

A strategy of linking primary chilled water plants at each hospital through a common underground distribution system was devised to minimize the capital cost for new centralized equipment while achieving the savings associated with district cooling systems. The study developed the technical and economic analyses and proposed a management structure to provide a mechanism for the equitable distribution of costs and savings.

42388 (ETDE-mf–9910823) **Framework concept for an integrated system covering sewage treatment, sewage sludge disposal, waste incineration, flue gas purification, flue gas scrubbing water treatment.** Dauber, S.; Frechen, F.B. Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl und Inst. fuer Siedlungswasserwirtschaft. Jun 1988. 90p. (In German). Contract BMFT 02 WS 872710. Order Number DE89910823/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; NTIS (US Sales Only), PC A05/MF A01.

In the FRG it is common practice that waste water and refuse from municipalities are disposed separately. The sewage sludges, occurring in waste water purification, can be looked upon as connection between liquid and solid waste materials. This connection actually calls for a central strategy for joint disposal. Only the combination of the systems to a complex, integral disposal system causes a high degree of safety in disposal by observing the following requirements: maximum protection of the environment, extensive energy recycling and thus conservation of the resources, minimization of the overall disposal costs. The strict fulfillment of these outline conditions and the consideration of the latest development trends in practice and research result in the integral framework concept presented. Main elements of this solution are: 1. an efficient waste water purification system with a two-stage anaerobic sludge treatment by using fine-grained coking coal from lignite, 2. an economic intensive digestion of the sewage sludge, 3. a combined incineration of refuse and sewage sludge with an optimized flue gas purification and residue utilization. (orig./RB).

42389 (IREQ–7403, pp. 22) **The pyrolysis of waste, an energy storage technique.** Chamberland, A. (Inst. de recherche de l'Hydro-Quebec, PQ, Canada); Theoret, A. Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). 1974. (In French). (CONF-7403113–: Stockage de l'energie, Varennes (Canada), 20 Mar 1974; CE–02476). In *Symposium. Energy storage.* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

A list of systems producing energy from waste around the world is given (incinerators, boilers, and pyrolysis plants). It is difficult to gather enough waste to produce even 6% of fuel needs. Sources of solid waste in Quebec are discussed. Composting and sanitary landfills are unattractive solutions, but the vapor from all incinerators in the Montreal region in 1976 could have provided 200 MW of power. Bioconversion, hydrogenation, and pyrolysis are the three main processes which convert waste into synthetic fuel. The U.S. Environmental Protection Agency considers pyrolysis to be the most attractive process. Under 1000^0F, the production of synthetic oil is favored, whereas above 1500^0F, the production of synthetic gas is favored, and the residual volume of waste is minimal. Data on the chemical composition of the pyrolysate are presented. Given the weak calorific power of the gas, oil seems to be of greater interest. Three large projects of pyrolysis plants in the U.S. are briefly presented. Pyrolytic oil could be mixed with no. 6 fuel oil to produce low sulfur fuel. Its possible use in the Tracy thermal power plant in Quebec is discussed. The Pompee project could treat 2.10^6 ton/y of urban waste from the Montreal region. The benefits of waste management are mainly ecological, but the energy produced from waste is not negligible. 2 figs., 7 tabs.

42390 (PB–89-164396/XAB) **Separate water metering of flats: lecture notes.** Malan, G.J. Council for Scientific and Industrial Research, Pretoria (South Africa). National Building Research Inst. 1987. 26p. (R/BOU–1512E). Available from NTIS, PC EE05/MF E05.

North American Continent sales only.

Water restrictions and tariffing systems designed to reduce wastage of potable water in urban areas have proved only partially successful in the case of multi-dwelling complexes with bulk metering. An investigation into the effect of individual metering and billing on the consumption of water in apartment buildings in Pretoria and East London has revealed that savings of 20-30% are attainable. Individual metering motivates tenants to attend to leaking fittings and is preferred by them to bulk metering. Individual metering would result in increased costs to the local authority, which may not be entirely offset by savings in the cost of water purchased from the bulk supplier. Retrofitting of individual meters in the great majority of existing multi-dwelling complexes is impractical; nevertheless, new buildings should be designed to allow for the installation of individual meters.

42391 (PB–89-187629/XAB) **Report to Congress: management of hazardous wastes from educational institutions.** Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste. Apr 1989. 128p. (EPA–530/SW-89/040). Available from NTIS, PC A07/MF A01.

The EPA has studied and evaluated the problems associated with managing hazardous wastes generated by educational institutions. This report is factual in nature. EPA was not directed by the law to develop recommendations for regulatory or statutory changes. The report identifies the statutory and regulatory requirements for educational institutions to manage hazardous waste, examines current hazardous-waste-management practices at such institutions, identifies the hazardous-waste-management problems encountered by them, and concludes by identifying possible ways for educational institutions to improve hazardous-waste management. The report primarily focuses on hazardous waste generated by universities, colleges, high schools, and vocational schools. The findings of the report can also apply to waste generated at facilities providing adult education and programs of education of less than 2 years' duration, because factors affecting the management of such waste would be similar for all levels and categories of educational institutions.

42392 (PB–89-189500/XAB) **Superfund Record of Decision (EPA Region 2): Kin-Buc Landfill, Operable Unit I, Edison Township, Middlesex County, New Jersey (first remedial action), September 1988.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. Sep 1988. 85p. (EPA/ROD/R–02-88/068). Available from NTIS, PC A05/MF A01.

The 220-acre Kin-Buc Landfill consists of a number of inactive industrial- and municipal-waste disposal areas and is located in the Raritan River 100-year flood plain and within a coastal zone in Edison Township, Middlesex County, New Jersey. Landfill operations were conducted between 1947 and 1977. Examples of wastes received include solvents, waste oils, paint sludges, cyanides, metal stripping waste and paint thinners. The selected remedial action for this site includes: installation of a slurry wall surrounding the site; RCRA capping over Kin-Buc II, a portion of the low-lying area between Kin-Buc I and the Edison Landfill, and Pool C; maintenance and upgrading, if necessary, of the Kin-Buc I cap; collection of approximately 3 million gallons of oily-phase leachate with offsite incineration and residual disposal; collection and onsite biological or carbon treatment of aqueous-phase leachate and contaminated ground water with discharge either to surface water or POTW, and dewatering of residual sludges and offsite disposal; ground water monitoring; and O&M.

42393 (PB–89-190615/XAB) **Operation and maintenance of hospital medical-waste incinerators. Final report.** Neulicht, R.M.; Turner, M.B.; Chaput, L.S.; Wallace, D.D.; Smith, S.G. Midwest Research Inst., Cary, NC (USA). Mar 1989. 212p. Available from NTIS, PC A10/MF A01.

This document identifies the operation and maintenance (O&M) procedures that should be practiced on hospital medical-waste incinerators and associated air pollution control equipment to minimize air emissions. Proper O&M, in addition to reducing air emissions, improves equipment reliability and performance, prolongs equipment life, and helps to ensure proper ash burnout. The document provides general guidance on proper O&M procedures with the intention of identifying good operating practices. The document is intended as a technical guide for use by federal, state, and local agency personnel, hospital waste management personnel, and hospital-incinerator operators. The document presents background information on hospital medical-waste incineration systems including a summary of combustion principles and descriptions of the types of incinerators typically used for hospital medical wastes. Background information on add-on air pollution-control systems is presented. Key operating parameters and good operating practices for the incineration and air pollution systems are identified and discussed. General guidance on maintenance of the systems is provided.

42394 (PB–89-861595/XAB) **Sludge dewatering: sewage and industrial wastes. January 1978-April 1989 (Citations from Pollution abstracts). Report for January 1978-April 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 92p. Available from NTISPC N01/MF N01.

Supersedes PB–88-857586.

This bibliography contains citations concerning techniques and equipment used in sewage, and industrial, mining, petroleum, and municipal waste sludge dewatering. Dewatering processes, device design, and performance evaluations are considered. (This updated bibliography contains 246 citations, 13 of which are new entries to the previous edition.)

42395 (WCWS–8409, pp. 253-264) **Operational audit assists design of plant modifications for energy savings and improved control.** Speirs, G. (Environmental Protection Service, Burlington, ON, Canada); Stephenson, J. Western Canada Water and Sewage, Calgary, AB (Canada). 1984. (CONF-8409417–: Western Canada water and sewage conference, Calgary (Canada), 19-21 Sep 1984; CE–02683). In *Proceedings of the [36th annual] western Canada water and sewage conference.* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

In 1982 the Wastewater Technology Centre (WTC) conmmissioned a study to select a full-scale municipal wastewater treatment plant to demonstrate energy conservation and improved operation through automated process control. Two new monitoring tools were use, both Apple II based. The first used a software package to estimate the overall oxygen mass transfer coefficient with an aeration tank. The second was an on-line instrument based data acquisitions package. The water treatment plant at Tillsonburg, Ontario was selected for evaluation of these tools. Real-time dynamic operating data obtained through the use of the audit equipment were valuable in assessing the operational capability of the sludge plant and in identifing equipment refit requirements.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

Refer also to citation(s) 43665

42396 (DOE/PE–0088, pp. 13, Paper 1) **Cost effectiveness of future fuel-economy improvements.** Difiglio, C.; Duleep, K.G.; Greene, D.L. USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC (USA). Office of Policy Integration. Dec 1988. In *1988 selected papers and presentations by DOE's Policy Integration Office staff.* Order Number DE89004611/JAW. Available from NTIS, PC A08/MF A01.

Improved automobile fuel economy has contributed and will continue to contribute greatly to reducing US dependence on imported oil. Since 1975, US oil consumption has fallen 2 million barrels per day lower than consumption would have been if automobile fuel efficiency did not improve. In today's competitive, international automobile market, we have every expectation that fuel economy will continue to improve and further reduce US oil demand. This paper provides estimates of the future level of fuel economy that can be expected because of economic efficiency (cost savings) and what we know about manufacturers' product plans. In addition, estimates are provided of the maximum technologically feasible level of fuel-economy improvement that can be expected independent of cost effectiveness. Finally, the costs of achieving levels of fuel economy even higher than provided by maximum feasible technology are estimated by considering the effects of shifting car-size mix towards smaller vehicles. 9 references, 6 figures, 6 tables.

3301 Internal Combustion Engines

Refer also to citation(s) 41547, 41587, 42407, 42410, 42412, 42420, 42421

42397 (AD-A–205636/4/XAB) **Effects of fuel properties and atomization on ignition in a T63 turbine combustor. Interim report, June 1985-December 1987.** Naegeli, D.W.; Dodge, L.G. Southwest Research Inst., San Antonio, TX (USA). Belvoir Fuels and Lubricants Research Facility. Dec 1987. 79p. (BFLRF–235). Available from NTIS, PC A05/MF A01.

Experiments were performed in a T63 gas-turbine combustor to gain a better understanding of the roles played by fuel properties, atomization, and air velocity and temperature in cold-start ignition. These results were used to improve the characteristic time model for ignition in gas turbine combustors. Ignition tests were performed on ten fuels while varying reference velocity, burner inlet temperature, fuel/air ratio, and the Sauter Mean Diameter of the fuel spray. Fuel viscosity and volatility were varied over a wide range. The test fuels ranged from gasoline to a heavy marine gas oil (HMGO). Two fuel groups were blended with identical viscosities, but with strikingly different 10% boil-off temperatures. To examine the effect of fuel composition on ignition, two fuels were blended with unusually high aromatic contents. Droplet size and spray structure were varied by using six atomizers.

42398 (AD-A–206054/9/XAB) **Role of sulfur oxides in wear and deposit formation in Army diesel engines. Interim report, October 1985-September 1987.** Naegeli, D.W.; Marbach, H.W. Southwest Research Inst., San Antonio, TX (USA). Belvoir Fuels and Lubricants Research Facility. Dec 1988. 71p. (BFLRF–248). Available from NTIS, PC A04/MF A01.

In some locations outside the continental United States, U.S. Military ground-mobility equipment uses fuel with an increased sulfur content. Fuel sulfur has been identified as a primary contributor to diesel-engine wear indicates that sulfuric acid mist formed within the combustion chamber is responsible for corrosive attack of the cylinder bore and piston-ring areas. Deposit formation has been more of a mystery in that the literature tends to support the theory that reaction of organically bound sulfur with the fuel and lubricant is the principal cause. Studies presented here suggest that sulfur dioxide (SO_2) formed in the combustion of fuel-bound sulfur is the primary

cause of higher cylinder bore/ring wear and deposit formation in diesel engines.

42399 (AD-A-206702/3/XAB) **Study of fuel dilution of diesel lubricating oil by gas chromatography/mass spectrometry. Technical memo.** Hiltz, J.A.; Veinot, D.E.; Haggett, R.D. Defence Research Establishment Atlantic, Dartmouth, NS (Canada). Jan 1989. 31p. (DREA-TM-89/203). Available from NTIS, PC A03/MF A01.

A method for the detection and identification of fuel components in diesel lubricating oil is described. The method uses a capillary gas chromatograph coupled to a quadrupole mass spectrometer to separate, detect, and identify diluents in the oil. A typical analysis takes 40 minutes. Accurate determination of the level of fuel dilution of a diesel lubricating-oil sample using GC/MS is shown to be dependent upon a number of factors including the source of the fuel, the age of the fuel, the thermal history of the fuel-diluted diesel oil sample and the availability of a suitable sample of fuel to prepare standard response versus concentration curves.

42400 (DOE/CE/90025-1) **Valve train forces and friction in advanced technology diesel engines: Annual progress report No. 1.** Rhein, R.E.; Mitchell, R.R.; Patterson, D.J.; Morrison, K.M.; Schwartz, G.B. Michigan Univ., Ann Arbor, MI (USA). W.E. Lay Automotive Lab. 30 Jun 1989. 13p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG02-88CE90025. Order Number DE89015376/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The purpose of this report is to record the objectives and current status of the DOE funded study of the forces and friction in the Cummins L-10 valve and injector train. Also included in the report is any pertinent information that should help maintain continuity of the program. The introduction of the report discusses the general goals of the program. These goals have changed throughout the development of the program. The current list reflects the expectations of the DOE and includes the development new measurement techniques that are needed by the diesel engine industry. The goals are discussed in more detail in the remainder of the report along with the current status and action required in the near future to attain the goals. 3 refs., 3 figs.

42401 (ETDE-mf-9911097) **Development of a direct-injection diesel engine with an Elsbett-Duotherm combustion system: Economically efficient car propulsion in consideration of future rigid emission standards.** Elsbett, L.; Elsbett, G.; Elsbett, K. Elsbett (L.) Konstruktion, Hilpoltstein (Germany, F.R.). Nov 1987. 38p. (In German). Contract BMFT TV8436B8. Order Number DE89911097/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01.

Under contract TV 8436 B 8 from the Bundesminister fuer Forschung und Technologie, and based on a 1.45 liter three-cylinder d.i. diesel engine with duothermic combustion system, the company Elsbett-Konstruktion in D-8543 Hilpoltstein carried out a development to combine optimized fuel economy with engine comfort characteristics as necessary for passenger car installation, under consideration of keeping the stringent exhaust emission standards. The conceptual details of the Elsbett technology first were analyzed and then further evaluated in comparison to other concepts by the Universitaet-Gesamthochschule Siegen. The targets of the contract have been met. In this way a practicable engine concept for passenger cars with direct injection diesel engine is introduced, with engine components ready for production. (orig.).

42402 (PB-89-177943/XAB) **Application of advanced diesel technology to inland waterway towboats. variable timing, electronic fuel injection. Final report, September 1985-January 1989.** Rowland, D.P. Detroit Diesel Corp., MI (USA). Mar 1989. 110p. Available from NTIS, PC A06/MF A01.

This report represents the test and evaluation of advanced diesel technology components on the DDC Series 149 Marine engine. The tests were conducted on an inland-waterways towboat and consist of over 20,000 engine hours of operation during the testing. The Detroit Diesel Series 16V-149 engine rated at 900 SHP was tested aboard the M/V ESCATAWPA owned and operated by Warrior and Gulf Navigation Company. Both port and starboard engines were instrumented to measure engine operating parameters, propeller-shaft torque, and fuel consumption. The data were collected by a computer-based data-acquisition system and written to floppy disc for analysis. The tasks included: (1) baseline evaluation of naturally-aspirated (NA) engines; (2) upgrade both engines to turbocharged intercooled and blower bypassed (TIB) configuration and measure performance; (3) upgrade port engine with Detroit Diesel electronic control (DDEC) and measure performance; (4) change port engine to high-torque rise governor setting and measure performance; (5) upgrade starboard engine with DDEC.

42403 (SAIC-86/65555) **Numerical simulation of internal combustion engine flows development and testing of turbulence and swirling flow capability.** Traci, R.M.; Su, F.Y.; Murty, S.; Boni, A.A. Science Applications International Corp., La Jolla, CA (USA). Sep 1980. 74p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC03-78ET13335. Order Number DE89016116/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The simulation of internal combustion engine flows provides both a unique challenge and opportunity for state-of-the-art models and numerical simulation techniques. The complexity of the simulation task is balanced by the promise of delivering new insights into the important reactive flow processes occurring and, hence, into the concomitant improvement in our ability to design engines that control those processes in a fuel efficient and low pollutant output manner. The goal of the project, for which the present report applies, was to develop, verify, and apply a numerical simulation technique for in-cylinder flow. This report represents the first in a series of reports which document the degree of progress made relative to that goal. In the following sections, the engine simulation model and the technical developments of the present effort are described. Those technical developments relate to the implementation, testing, and validation of two important model capabilities: turbulent transport and swirl flow modeling. The present report is composed of three main sections. The overall model equations are presented in Section 2 followed by a summary discussion of the numerical simulation approach in Section 3. Section 4 contains the principal results of the current effort including discussion of the turbulence model with initial test calculations and the application of the model to important and realistic but idealized IC engine flows. Finally, a summary discussion and plans for the continuing effort are presented in Section 5. 6 refs., 33 figs.

3302 External Combustion Engines

42404 (ENEA-RT-FARE-85-2) **Stirling-Beale engine: bench-scale experiments (Italy).** Carlini, M.; Conti, M.; Mennini, G.; Tata, P. Rome Univ. (Italy); ENEA, Casaccia (Italy). Dipt. Fonti Alternative e Risparmio Energetico. Jan 1985. 70p. (In Italian). Order Number DE89761950/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

A project, involving collaboration between ENEA (Italian Commission for Nuclear and Alternative Energies) and the Dipartimento di Meccanica e Aeronautica dell'Universita "La Sapienza" of Rome, is being undertaken in the field of energy saving. Within the framework of such theoretical-experimental activity, this report deals with the design, assembly and calibration of a test bench for a small power (max 100 W) free piston and external combustion engine, working according to the Stirling cycle. This report also illustrates modifications made to a Stirling-Beale engine installed and tested on the test bench. Some examples of experimental data together with diagrams elaborated by computer simulation conclude the work.

42405 (PB-89-864169/XAB) **Stirling engines. January 1984-June 1989 (Citations from the NTIS data base). Report for January 1984-June 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 149p. Available from NTISPC N01/MF N01.

Supersedes PB-88-864640.

This bibliography contains citations concerning Stirling engine technology. Design, performance testing, development, engine problems, temperature control, computerized simulation, and reliability are considered. Applications of various types of Stirling engines to automobiles, the utilization of solar energy, and an artificial heart system are included. (This updated bibliography contains 273 citations, 36 of which are new entries to the previous edition.)

3303 Electric-powered Systems

Refer also to citation(s) 42201, 42337

42406 (OTC–RT-87-01) **Advanced light rapid transit. A Canadian achievement.** AppaRao, T.A.P.S. Ontario Ministry of Transportation and Communications, Ottawa, ON (Canada). 1987. 17p. (CONF-8709458–: RTAC annual conference, Saskatoon (Canada), Sep 1987; MICROLOG–87-05955). Available from Ont. Min. of Transportation and Communications, R & D Branch, 1201 Wilson Ave., Downsview, ON, CAN M3M 1J8; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Advanced Light Rapid Transit (ALRT) System has been developed in Canada to provide a cost-effective, flexible, environmentally acceptable and high-quality service solution for medium-capacity transit applications. ALRT systems have been in revenue service in Toronto since 1985, Vancouver since 1986 and Detroit since 1987. The ALRT system is designed for capacity range of 10,000 to 30,000 pphpd (people per hour per direction). Thus, it fills the capacity gap between buses (5000 pphpd) and subways (40,000 to 50,000 pphpd). The capacity of this system makes it well suited to feeder and suburban lines in large cities and main lines in medium-sized cities. The ALRT system uses small vehicles 12.5 m long and 2.5 m wide. The cars have seating for 30 to 40 passengers depending on interior configuration and a design capacity of 75 passengers. The maximum operating speed of the the vehicle is 90 km/h. The vehicles use a linear induction motor for propulsion and braking, and the ALRT system is fully automated and capable of operating with time intervals between trains of as little as 60 seconds. Three ALRT systems in use are described. Current operating data indicate that operating costs are substantially lower than with other light rail systems. 7 refs 8 figs.

3304 Hybrid Systems

Refer also to citation(s) 42201

3305 Flywheel Propulsion

Refer also to citation(s) 42177

3306 Vehicle Design Factors

Refer also to citation(s) 42404

3307 Emission Control

Refer also to citation(s) 41552, 41603, 43370

42407 (ETDE-mf–9795633) **Supplementary measures to reduce emissions on a medium-sized passenger vehicle. Final report. Pt. 1.** Technische Universitaet Berlin, Institut fuer Fahrzeugtechnik. Bericht. Darvish, M.; Gern, G. Technische Univ. Berlin (Germany, F.R.). Inst. fuer Fahrzeugtechnik; Umweltbundesamt, Berlin (Germany, F.R.). Jul 1987. 189p. (In German). Contract UFOPLAN-Nr. 10405504. Order Number DE89795633/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; NTIS (US Sales Only), PC A09/MF A01.

Mid-size cars powered by Otto engine have been modified with standard accessories, suitable for a later installation. These cars have been examined on emission behaviour and fuel economy by using a chassis dynamometer. Distinctive suitable modifications have been combined and tested on qualification in practice with cars of the fleet with an engine displacement of less than 1.41 and more than 1.41. An enduring test (30.000 km) has exemplarily shown the process of aging of catalysts. The report is finished with a profit and expenses analyses. (orig.) With 15 refs., 99 tabs., 8 figs.

42408 (PB–89-169882/XAB) **Evaluation of refrigerant from mobile air conditioners. Report for April 1988-Jauary 1989 (Final).** Weitzman, L. Acurex Corp., Research Triangle Park, NC (USA). Southeast Regional Office. Feb 1989. 75p. Available from NTIS, PC A04/MF A01.

This report gives results of a project to provide a scientific basis for choosing a reasonable standard of purity for recycled chlorofluorocarbon (CFC) refrigerant in operating automobile air conditioners. The quality of refrigerant from air conditioners in automobiles of different makes, ages, and mileages, from different parts of the U.S., and with both failed and properly working air conditioners was measured. The refrigerant (CFC-12) was tested for water content, acidity, residue (compressor oil) quantity, refrigerant purity, inorganic chloride, and inorganic fluoride. Of the 227 cars sampled, neither the refrigerant nor the residue showed measurable levels of acid or inorganic chlorides and fluorides. The gaseous refrigerant, in all but two samples, was of higher purity than the specification for new CFC-12. The residue was greater than 99% pure in all but two samples. The mean water content for all samples (56 ppm) exceeded the Federal Specification BB-F-1421A of 10 ppm maximum. The work will be the basis for programs to reduce CFC emissions from the servicing of automotive air conditioners.

42409 (PB–89-170203/XAB) **MOBILE4 emission factor model: source code (one version mixed case, one version upper case), input files for example runs, and high-altitude-area I/M credits. Model.** Newell, T.P.; Parsons, R. Environmental Protection Agency, Ann Arbor, MI (USA). Emission Control Technology Div. 1 Mar 1989. mag ta Available from NTISCP T99.

Supersedes PB–84-221795. For system on diskettes, see PB–89-170211; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB–89-164271.

MOBILE4 is a computer program that calculates emission factors for hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx) from highway motor vehicles. MOBILE4 calculates emission factors for eight individual vehicle types, in two regions of the country (low- and high-altitude). The emission factors depend on various conditions such as ambient temperature, fuel volatility, speed, and mileage accrual rates. MOBILE4 will estimate emission factors for any calendar year between 1960 and 2020 inclusive. The 20 most recent model years are considered in operation in each calendar year. MOBILE4 supersedes MOBILE3. Relative to MOBILE3, MOBILE4 incorporates several new options, calculating methodologies, emission control regulations, and internal program designs. Software Description: The model is written in the FORTRAN programming language for use on an Amdahl 5890-18DE computer using the MTS operating system. Minimum memory required is 920K.

42410 (PB–89-177950/XAB) **Tandem mass spectrometry (MS/MS) for analysis of substituted polycyclic aromatic compounds in extracts of diesel-exhaust particulates. Final report.** Hayes, R.N.; Cerny, R.L.; Gross, M.L. Nebraska Univ., Lincoln, NE (USA). Dept. of Chemistry. 30 Sep 1988. 32p. Available from NTIS, PC A03/MF A01.

See also PB–86-222197.

The project developed tandem mass-spectrometric techniques for the analysis of the polar fractions from the soluble organic fractions of NBS SRM No.1650 diesel-exhaust particulates. Three subfractions, numbered Fractions 7 through 9, were used for the development. Instrumentation utilized was a Kratos MS-50 triple analyzer, which consists of a high-resolution MS-I, a standard Kratos MS-50, and a low resolution MS-II, an electrostatic analyzer. Two modes of spectrometer scanning, acquisition of daughter-ion spectra, and constant neutral loss (CNL) were explored. Two methods of sample ionization, Fast atom bombardment (FAB), and electron ionization (EI) were investigated. Negative-ion chemical ionization (NICI) was subsequently investigated to improve specificity and sensitivity. The MS/MS spectra of 12 nitro-PAH standards were determined and a detection limit of 1 picogram of material was established.

42411 (PB–89-180822/XAB) **Evaluation of a FTIR (Fourier Transform Infrared Spectrometer) mobile source measurement system. Status report.** Sigsby, J.E.; McArver, A.; Snow, R. Northrop Services, Inc., Research Triangle Park, NC (USA). Apr 1989. 45p. Available from NTIS, PC A03/MF A01.

An initial evaluation was made of a prototype Fourier-transform infrared spectrometer on its ability to measure mobile source emissions. This prototype represents the commercialization of research technology developed by the Ford Motor Co. The system utilizes a Mattson Instruments Co. interferometer coupled to a Masscomp computer. The required software is still incomplete. This has resulted in the inability to correct errors or optimize results. Unreliability of both hardware and software has been a major shortcoming of the system. When operating properly, the system measures carbon dioxide, nitric oxide, and formaldehyde accurately, both when compared to bag analysis and on direct point-by-point comparisons with real-time data. Completion of the evaluation awaits the final software translations and improvements in reliability.

42412 (PB–89-181796/XAB) **Characterization of exhaust emissions from trap-equipped light-duty diesels. Final report.** Smith, L.R. Southwest Research Inst., San Antonio, TX (USA). Jan 1989. 319p. (SWRI–1280). Available from NTIS, PC A14/MF A01.

The objective of the project was to thoroughly characterize and quantify the criteria and toxic-pollutant emissions from two different types of trap-equipped light-duty diesel vehicles. These vehicles included a 1986 Mercedes-Benz 300 SDL, which utilizes a catalyzed trap system, and a prototype Volkswagen, which utilizes an additive trap system (organometallic iron additive). Exhaust emissions from the two vehicles were evaluated as to driving cycle, presence of traps, engine condition, trap condition and fuel aromatic content. In addition to the currently regulated emissions (HC, CO, NOx and particulate matter), a number of unregulated emissions were measured, including aldehydes, benzene, PAHs, metals and trace elements, and 1,3-butadiene. Particulate samples were also analyzed for mutagenic activity using the Ames test. In general, the vehicles produced lower hydrocarbon emissions, higher carbon monoxide emissions, and lower fuel economy when the traps were installed in the vehicles.

42413 (UBA-FB–86-081) **Determination of concentration fields generated by vehicle emissions in different types of urban streets.** Umweltbundesamt - Texte. GEOMET-Umweltberatung und Regionalplanung G.m.b.H., Berlin (Germany, F.R.); Umweltbundesamt, Berlin (Germany, F.R.). Jul 1987. 114p. (In German). Contract UFOPLAN-Nr. 10402432/01. Available from Umweltbundesamt, Berlin (Germany, F.R.).

An effective tool for use in the evaluation of air quality control strategies within urban street canyons with varying canyon geometry (in the form of varying canyon height to width ratios) is developed. The models calculate the pollution levels of inert gases (e.g. CO, NO_x, CH) emitted by traffic. The models are capable of taking into account the NO-NO_2 conversion. Model output are 30 min. mean values of pollutant concentration in user-selected locations within street canyons. These mean values can be used to calculate long-term average values. Input data do not exceed the scope of existing (empirical) models. Emission input for the dispersion model can be derived from a specially designed, traffic flow and emission model for city street networks. (orig.) With 31 refs., 14 tabs., 21 figs.

3308 Alternative Fuels

Refer also to citation(s) 41549

42414 (AD-A–205635/6/XAB) **Evaluation of potential engine oils for use in administrative vehicles operating on M85 methanol fuel. Interim report, July 1985-November 1988.** Baber, B.B. Southwest Research Inst., San Antonio, TX (USA). Belvoir Fuels and Lubricants Research Facility. Dec 1988. 101p. (BFLRF–260). Available from NTIS, PC A06/MF A01.

Six lubricants, comprised of various lubricant formulations, were evaluated to determine which potential engine oil would provide more wear and/or corrosion protection for administrative-type vehicle engines operating on M85 methanol fuel. The six lubricants were first evaluated using a modified ASTM V-D cyclic test procedure. The three best oils were then evaluated in a second test series using steady-state/cold test conditions. These three oils provided the same order of protection from wear and corrosion in the steady-state/cold test conditions as they provided using the cyclic test conditions. All three lubricants coded AL-15427-L, AL-16155-L, and AL-15610-L are recommended for use in administrative-type vehicle engines when operating on M85 methanol fuel.

42415 (DOE/PE–0088, pp. 12, Paper 2) **Economic and security issues of methanol supply.** Difiglio, C.; Lawrence, M.F. USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC (USA). Office of Policy Integration. Dec 1988. In *1988 selected papers and presentations by DOE's Policy Integration Office staff.* Order Number DE89004611/JAW. Available from NTIS, PC A08/MF A01.

Use of methanol as a net motor fuel has the potential to reduce US oil imports and enhance US energy security. The extent to which methanol use can achieve this potential depends on several economic and security issues discussed in this paper. The analytic framework under which methanol use is evaluated postulates the gradual introduction of fuel-flexible vehicles so that, at some future date, a significant amount of gasoline use can be displaced by methanol. The benefits of using methanol are measured by the cost advantage methanol can provide over gasoline and the effect methanol use may have to reduce world oil prices. In addition, energy security will be further enhanced if methanol can be provided by a more diverse set of suppliers than current oil exporters and if these methanol exporters are in more secure regions of the world. This paper summarizes current estimates of methanol cost in the short and long run and describes an ongoing analytic effort to understand the future methanol market in more detail. The potential benefits and cost of methanol use are outlined and other energy policy issues are defined including security of methanol suppliers and OPEC strategy. 5 references, 5 figures, 3 tables.

42416 (DOE/PE–0088, pp. 14, Paper 3) **Timing of methanol supply and demand: implications for alternative transportation fuel policies.** Difiglio, C. USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC (USA). Office of Policy Integration. Dec 1988. In *1988 selected papers and presentations by DOE's Policy Integration Office staff.* Order Number DE89004611/JAW. Available from NTIS, PC A08/MF A01.

Methanol has become a leading alternative fuel candidate to enhance US energy security. However, in order to have a significant impact on US energy security, methanol would have to be available to the US market in sufficient quantities to substantially reduce US oil use. Unless methanol use in transportation were large enough to reduce US oil demand by upwards of a million or more barrels per day, US oil imports would not be reduced sufficiently to have a significant impact on the world oil market. Static-equilibrium analysis is essential to delineate the detailed set of demand and supply interactions in the world oil and gas markets. However, the results of static-equilibrium analysis should not be interpreted as representing achievable outcomes until timing is explicitly accounted for. This paper provides a framework for analyzing the interrelationship between timing and static-equilibrium estimates and to explore implications that this interrelationship could have on alternative transportation fuel policies. 7 references, 1 appendix, 14 figures, 1 table.

42417 (DOE/PE–0088, pp. 9, Paper 5) **Alternative-fuels market development: Elements of a transition strategy.** McNutt, B. USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC (USA). Office of Policy Integration. Dec 1988. In *1988 selected papers and presentations by DOE's Policy Integration Office staff.* Order Number DE89004611/JAW. Available from NTIS, PC A08/MF A01.

The focus of this paper is a strategy for a transition away from transportation oil dependence. The argument has been made that methanol is the most logical transition fuel. This also seems to be the fuel of choice for several of the key players in the transportation arena. With the development of relatively inexpensive fuel-flexible vehicle technology, the auto manufacturers have committed to methanol. Environmental agencies are pursuing methanol as a clean fuel to achieve air-quality goals. While these actions do not foreclose other fuels - e.g., compressed natural gas (CNG) - it is unlikely that two alternative fuels will enter widespread use. The question is whether the policies pursued should be or need to be fuel-specific. If the policy is fuel-specific - i.e. one fuel not many - how does that choice get made institutionally or politically. Or, in the case of methanol, is there a de facto ratification of the auto-manufacturer's choice by government as occurred in the early 1970's for unleaded

gasoline. While the strongest arguments can be made for methanol, it seems clear that CNG and electricity may have small but important niche markets where they can dominate economically.

42418 (DOE/PE–0088, pp. 15, Paper 6) **Cost of making methanol available to a national market.** McNutt, B.; Dowd, J.; Holmes, J. USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC (USA). Office of Policy Integration. Dec 1988. In *1988 selected papers and presentations by DOE's Policy Integration Office staff.* Order Number DE89004611/JAW. Available from NTIS, PC A08/MF A01.

The US Department of Energy has completed the first phase of its analysis of the components and cost of a methanol-fuel-compatible transportation infrastructure. This paper integrates the results of that analysis with other analyses on likely infrastructure and market development issues to estimate the cost of putting methanol fuel (M-85) in the market place. Unit and overall costs are estimated for various infrastructure components including fuel terminals, retail outlets, and vehicles. The infrastructure costs are considered in the context of a methanol-utilization scenario based on assumptions about future methanol and oil prices and consumer behavior. Methanol use is determined by the competitive economics but evolves within the developed infrastructure, which is assumed to be driven by non-market forces. 2 figures, 4 tables.

42419 (DOE/PE–0088, pp. 12, Paper 14) **Methanol's contribution to energy security in the USA.** Stagliano, V.A.; Ecklund, E.E. USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC (USA). Office of Policy Integration. Dec 1988. In *1988 selected papers and presentations by DOE's Policy Integration Office staff.* Order Number DE89004611/JAW. Available from NTIS, PC A08/MF A01.

Alternative transportation fuels are being closely examined as a feasible option to reduce reliance on petroleum imports from unreliable suppliers. Although energy security considerations are a major driving force behind alternative-fuels considerations, ambient air-quality concerns are the most-immediate factors in current actual alternative fuel use. Diversity of supply sources, technological feasibility and economics indicate that methanol is likely to emerge as the most feasible, general, alternative transportation fuel, used in a flexible system in conjunction with petroleum. Special-purpose markets for alternative-fuels-dedicated systems are deemed both feasible and desirable in order to diversify transportation energy requirements, reduce the currently inflexible linkage between the transportation sector and petroleum, and increase economic and technological competition among transportation systems. 7 references, 4 figures, 3 tables.

42420 (ETDE-mf–9795482) **Investigation of the combustion process of alternative fuels. Final report.** Herweg, R.; Koehler, J.; Saggau, B.; Striebel, H.C.; Ziegler, G.F.W. Stuttgart Univ. (Germany, F.R.). Inst. fuer Physikalische Elektronik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Mar 1986. 152p. (In German). Contract BMFT 522-7291 TV 8348 8. Order Number DE89795482/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01.

A number of combustion parameters were determined for methanol, methyl-tertiary-butyl ether (MTBE), tertiary butyl alcohol (TBA), methanol/MTBE and methanol/TBA mixtures, and octane/MTBE and octane/TBA mixtures. The parameters were: laminar flame velocities, flame front velocities, flame front thickness, maximum combustion temperature, and the temperature profile in the flame front. Compared with methane or methanol, these higher alcohols have lower combustion rates in the rich and stoichiometric range and comparable combustion rates in the lean fuel range. The injection jets of methanol and diesel fuel were investigated in a high-pressure chamber using schlieren, dual-pulse schlieren, and laser light section techniques. Methanol droplets are about 10% smaller in diameter at nearly double ejection speed. (orig.).

42421 (PB–89-164628/XAB) **Evaluation of ignition-improved methanol as an alternative fuel for heavy-duty diesel engines.** Myburgh, J.S.; Weiss, E.K.J. Council for Scientific and Industrial Research, Pretoria (South Africa). National Mechanical Engineering Research Inst. 1989. 8p. (CSIR-ME–519). Available from NTIS, PC EE04/MF E04.

North American Continent sales only.

Ignition-improved methanol is suitable as an alternative fuel for heavy-duty engines. Its use in diesel engines reveals some attractive properties, e.g., low black smoke and NOx emission. Due to the lower heat value of methanol, the injection equipment must be able to deliver a larger fuel-quantity as a necessary precondition for the conversion from diesel fuel to methanol operation. Methanol may induce some fuel specific wear problems. Therefore, it will not always be possible to convert an engine with off-the-shelf components. Further development work will have to be done to modify engine parts and materials and adjust lubricating-oil properties.

42422 (PB–89-178792/XAB) **Feasibility demonstration of the Thermal Ignition Combustion System (TICS) for high-pressure natural-gas-injected engine.** Kalwani, R.M.; McNulty, D.; Badgley, P.; Kamo, R. Adiabatics, Inc., Columbus, IN (USA). Feb 1989. 73p. (AI–84-15-1). Available from NTIS, PC A04/MF A01.

The objective of the program was the feasibility demonstration of the Thermal Ignition Combustion System (TICS) concept for the ignition and combustion of high-pressure injected natural gas. The TICS concept relies on the ignition of fuel by high-temperature combustion chamber walls without external ignition sources like spark plug, glow plug, or pilot diesel fuel. The program was successful in achieving ignition and combustion of natural gas in a single cylinder diesel engine with the TICS concept. An electronically controlled gas injector, designed and fabricated in the program, was used to inject natural gas at 13.8 to 20.7 MPa (2000 to 3000 psig) pressure in the TICS chamber. Cold starting of the test engine was achieved by external heating of the chamber for a few minutes. Natural gas ignition and combustion was then sustained by the high-temperature TICS chamber. The test engine was operated from idle to full load and from 600 to 1400 rpm engine-speed range.

35 ARMS CONTROL

3501 Policy, Negotiations, and Legislation

42423 (PB–89-861843/XAB) **Strategic defense and arms control. January 1970-April 1989 (Citations from the NTIS data base). Report for January 1970-April 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 68p. Available from NTISPC N01/MF N01.

Supersedes PB–88-858972.

This bibliography contains citations concerning studies of relationships between national defense needs and arms control policies. Included are references to specific weapons systems and initiatives, such as the cruise missile, MX missile, Trident, non-nuclear strategic weapons, and chemical weapons; and strategies involving space, NATO, and the Strategic Defense Initiative. Policies, positions and negotiations refer to the Strategic Arms Limitation Talks (SALT), the Strategic Arms Reduction Talks (START), the Anti-ballistic Missile Treaty, and international meetings on proliferation of weapons, and on use of space for military missions. (This updated bibliography contains 118 citations, 13 of which are new entries to the previous edition.)

3502 Proliferation

Refer also to citation(s) 42423

42424 (SAND–89-8508) **A background traffic activity analysis in a canonical NATO [North Atlantic Treaty Organization] defense.** Rogers, J.N.; Tooman, T.P. Sandia National Labs., Livermore, CA (USA). Apr 1989. 130p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DR00789. Order Number DE89011327/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

A canonical defense study in a NATO brigade sector on the northern flank of the US V Corps sector in the Federal Republic of Germany is wargamed to depict the expected vehicular movements during a 24 hour time period. All NATO and Warsaw Pact situations and forces played intentionally portray a "normal" battlefield situation, that is one in which events occur according to the established

tactics and doctrines for both NATO and WP forces. Activity details which are almost always ignored in broader studies are included. The periodic displacement of high value units (e.g., artillery, air defense, headquarters and target acquisition) to preclude enemy fixing and targeting; the resupply down to company and occasionally platoon level of ammunition, petroleum, rations, etc.; the movement of commanders and staffs; the activity of combat engineers to include site preparation, construction and minefield emplacement; the action of reconnaissance and patrol units; the security of the rear area and POW processing; and the evacuation of casualties are analyzed. The resulting database records the position for every vehicle in both forces at each minute during the period of analysis and is thus an ideal framework for a variety of further studies, such as analyses of intelligence collection devices and modern ordinances. 9 refs., 30 figs., 9 tabs.

36 MATERIALS

42425 (JINR-N–5(31)-88) **JINR rapid communications. Collection of papers.** Joint Inst. for Nuclear Research, Dubna (USSR). 1988. 44p. Order Number DE89012200/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Individual papers are processed separately.

42426 Interfacial structure, properties and design; Proceedings of the Symposium, Reno, NV, Apr. 5-8, 1988. MRS Symposia Proceedings. Volume 122. Yoo, M.H.; Clark, W.A.T.; Briant, C.L. 628p. Materials Research Society, Pittsburgh, PA (1988). (CONF-8804112–: Interfacial structure, properties and designs in solids, 5-9 Apr 1988).

The present conference on materials interfacial phenomena discussed topics on interface structural characterization and analysis, the thermodynamics of interface structures, interfacial diffusion and segregation phenomena, interfacial elasticity and localized deformation, the relationship of interface cohesive strength to intergranular fracture, processing methods for alloy design, structural ceramics and ceramic superconductors, heterophase interfaces, and thin films. Attention is given to the crystallization theory of dislocations in interfaces, a new model for the simulation of interfaces at high temperature, grain boundaries in a two-dimensional superlattice, internal interfaces in high-temperature superconductors, applications of grain boundary engineering to anomalous grain growth, and recent developments in epitaxial silicides.

3601 Metals and Alloys

Refer also to citation(s) 41485, 41491, 41496, 41690, 41695, 41800, 41924, 41994, 42017, 42019, 42041, 42076, 42398, 42995, 42997, 42998, 43012, 43101, 43153, 43290, 44012, 44044, 44137, 44254, 44322

42427 (ACI–370002) **To determine the dynamic toughness properties of cast steels. Final report.** Alloy Casting Industries Ltd., New Hamburg, ON (Canada). [1989]. 64p. (MICROLOG–87-02526). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

With increasing exploration activities in northern regions and in offshore areas, were adverse environmental conditions are encountered, the establishment of low temperature fracture toughness properties of cast steels has become a necessity. A program on the fracture toughness testing of commercially produced cast steels was performed. The program consisted of he evaluation of Charpy V-notch, and plane strain and dynamic fracture toughness properties of test materials derived from different size castings (2 and 5 in) at cryogenic temperature. Two steel compositions were chosed for testing, representative of the low temperature grouping as defined in the American Society for testing and Materials (ASTM) Standard Specification A352. The test results suggested that even at cryogenic temperature, a large compact tension sample (larger than 1-1.2" in width) is required to meet the ASTM E399 requirements of a valid plane strain fracture tougher. Compared to the dynamic fracture toughness test results, the Charpy V-notch results always indicated higher ductile/brittle transition temperatures for the above test materials. In addition, the size of the castings (2 or 5 in) did not have significant effect on the ductile/brittle transition temperatures. 2 refs., 18 figs., 5 tabs.

42428 (AD-A–205596/0/XAB) **Formation and stability of aluminum-based metallic glasses in Al-Fe-Gd alloys.** He, Y.; Poon, S.J.; Shiflet, G.J. Virginia Univ., Charlottesville, VA (USA). 1988. 5p. Available from NTIS, PC A02/MF A01.

Pub. in Scripta Metallurgica, Vol. 22, No. 11, 1813-1816(1988).

Metallic glasses, a class of amorphous alloys made by rapid solidification, have been studied quite extensively for almost thirty years. It has been recognized for a long time that metallic glasses are usually very strong and ductile, and exhibit high corrosion resistance relative to crystalline alloys with the same compositions. Recently, metallic glasses containing as much as 90 atomic percent aluminum have been discovered independently by two groups. This discovery has both scientific and technological implications. The formability of these new glasses has been found to be unusual. Studies of mechanical properties in these new metallic glasses show that many of them have tensile strengths over 800 MPa, greatly exceeding the strongest commercial aluminum alloys. The high strengths of aluminum-rich metallic glasses can be of significant importance in obtaining high strength low density materials. Therefore, from both scientific and technological standpoints, it is important to understand the formation and thermal stability of these metallic glasses. Al-Fe-Gd alloys were chosen for a more-detailed study since they exhibit high tensile strengths.

42429 (AD-A–205664/6/XAB) **Atomic relaxation and vacancy-interstitial recombination in Zr and Zr3Al. Master thesis.** Menzella, V.M. Naval Postgraduate School, Monterey, CA (USA). Dec 1988. 96p. Available from NTIS, PC A05/MF A01.

This thesis examines two problems associated with crystalline defects in the materials Zr and Zr_3Al, by means of a molecular-dynamics simulation. In the first problem, the relaxed configuration around a single vacancy, a di-vacancy and a tri-vacancy are computed by introducing the defect into a perfect lattice and dynamically relaxing the crystal until it attains equilibrium. The results are in qualitative agreement with static studies but show clearly that first and second neighbors have different relaxed states depending on their configuration in the initial crystal lattice.

42430 (AD-A–205671/1/XAB) **Mechanical properties of aluminum-rich Al-Fe-Gd metallic glass.** Shiflet, G.J.; He, Y.; Poon, S.J. Virginia Univ., Charlottesville, VA (USA). 1988. 9p. Available from NTIS, PC A02/MF A01.

Pub. in Scripta Metallurgica, Vol. 22, No. 10, 1661-1664(1988).

It is expected that this class of alloys will receive much attention as potential high-strength, low-density materials. This work has shown that a large number of ternary aluminum alloys can lead to metallic-glass aluminum. Although the alloys discussed in this paper have moduli lower than commercial aluminum alloys, it is expected that with further research, properties can be optimized. A better understanding of factors that influence aluminum glass formation is, therefore, of much practical interest.

42431 (AD-A–205710/7/XAB) **Magnetic studies of $RCo_{12}B_6$ compounds (R = Y, Ce, Pr, Nd, Sm, Gd and Dy).** Jurczyk, M.; Pedziwiatr, A.T.; Wallace, W.E. Carnegie-Mellon Univ., Pittsburgh, PA (USA). 1987. 4p. Available from NTIS, PC A02/MF A01.

Pub. in Jnl. of Magnetism and Magnetic Materials, Vol. 67, L1-L3(1987).

In the course of a search for new permanent-magnet materials, several studies were performed on the magnetic behavior of the family of R-Co-B system. In this investigation these studies were extended to $RCo_{12}B_6$ systems. These compounds crystallize in a rhombohedral $SrNi_{12}B_6$-type crystal structure. It was reported that $SmCOP_{12}B_6$ has a Curie temperature of 708 K and a saturation magnetization, Ms=0.108 T. Our investigation indicates that $RCo_{12}B_6$ compounds for R= yttrium, cerium, praseodymium, neodymium, samarium, gadolinium and dysprosium are nonmagnetic at room temperature.

42432 (AD-A–205888/1/XAB) **Corrosion of high-density sintered tungsten alloys. Part 3. Electrochemical tests.** Batten, J.J.; Bombaci, S.A.; Garrard, W.N.; Moore, B.T.; Smith, B.S. Materials

Research Labs., Ascot Vale (Australia). Dec 1988. 45p. (MRL-R-1146). Available from NTIS, PC A03/MF A01.

See also Part 1, AD-A204 962.

The corrosion behavior of tungsten and high-density tungsten alloys (W greater than or equal to 90 weight %) was examined electrochemically through anodic polarization measurements, instantaneous corrosion rate measurements, galvanic coupling, and surface potential mapping. In the anodic polarization tests, pure tungsten and the four alloys studied underwent transitions from an active state to a state where any further increase in potential produced no further increase in current. The presence of chloride ions increased corrosion rates. Predictions of likely trends in corrosion rates from the above electrochemical tests were not in complete agreement with those obtained by the long-term immersion tests. Similarly, a consistent prediction of the likely nature of the corrosion products that would result from long-term immersion testing was not obtained from the above studies. Predictions about which alloys would be susceptible to a crevice effect were in agreement with the immersion testing results, namely those alloys not containing Cu would be most susceptible.

42433 (AD-A-206072/1/XAB) **Environmental effects in niobium-base alloys and other selected intermetallic compounds. Annual report No. 1, 1 November 1987-31 October 1988.** Meier, G.H.; Thompson, A.W. Pittsburgh Univ., PA (USA). Dept. of Materials Science and Engineering. 15 Dec 1988. 68p. Available from NTIS, PC A04/MF A01.

Niobium aluminides and silicides as well as other intermetallic compounds have potential for use in advanced gas turbines where increased operating temperatures are necessary to obtain the targeted performance goals. These materials will be subjected to a variety of environments over a range of temperatures. Two of the principal reactants in these environments are oxygen and hydrogen. This program is concerned with the effects of oxygen and hydrogen on niobium alloys and other selected intermetallic compounds. This program consists of two parts. The investigations involving oxygen are directed toward describing the conditions that must be achieved in order to have a continuous, protective aluminum oxide or silicon dioxide scale developed on niobium-base alloys and compounds, and other selected intermetallics, at temperatures between 600 and 1400 C. The studies concerned with hydrogen effects are directed toward determining solubility limits, hydrogen uptake and permeation rates, and the degree to which hydrogen degrades the mechanical properties of these materials. (aw)

42434 (AD-A-206169/5/XAB) **Influence of hydrogen on the magnetic properties of hyperstoichiometric $ZrMn_2T_{0.8}$ (T = Fe, Co, Ni and Cu).** Zhang, L.Y.; Pedziwizatr, A.T.; Pourarian, F.; Wallace, W.E. Carnegie-Mellon Univ., Pittsburgh, PA (USA). 1987. 6p. Available from NTIS, PC A02/MF A01.

Pub. in Jnl. of Magnetism and Magnetic Materials, Vol. 68, 309-313(1987).

Magnetic properties have been investigated for the hyperstoichiometric ZrMn2T(0.8) (T = Fe, Co, Ni and Cu) systems and their hydrides. Hydrogenation is accompanied by a large expansion in unit-cell volume, ranging from 22 to 26% with no change in crystal structure. Hydrogenation enhances magnetism in all cases. The system exhibits susceptibility behavior that can be fit to an expression of the form X=XO + C/-Theta. XO is appreciable for all materials studied except $ZrMn_2Cu(0.8)$, for which XO is negligible. The unusual history-dependent magnetic behavior of the hydrides studied below 80 K very likely is a consequence of their spin-glass-like behavior. A comparison of the present results with those of their counterpart $ZrCrFeT_{0.8}$ is included.

42435 (AD-A-206234/7/XAB) **Effect of finite size on magnetoresistance.** Lee, H.R.; Oh, H.G.; George, T.F.; Um, C.I. State Univ. of New York, Buffalo, NY (USA). Dept. of Physics and Astronomy. 1 Feb 1989. 5p. Available from NTIS, PC A02/MF A01.

Pub. in Physical Review B, Vol. 39, No. 4, 2822-2825(1 Feb 1989).

Finite-size effects are studied for magnetoresistance in a disordered metallic system. Quantum corrections to the conductivity are strongly affected by the presence of an in-plane magnetic field in a thin film. They are also affected significantly by the boundaries of the finite quantum size. Expressions are obtained for the quantum correction to the conductivity due to both effects. The dephasing characteristic time scale due to the magnetic field is found by the exact eigenvalues of the system. One- two-, and three-dimensional results can be obtained with the proper limits. Some numerical results are presented for the given inelastic scattering length.

42436 (AD-A-206420/2/XAB) **Optimisation of the figure of merit of modified silicon-germanium alloys. Final technical report, 1987-1989.** Rowe, D.M. University Coll., Cardiff (UK). Dept. of Physics. Feb 1989. 23p. Available from NTIS, PC A03/MF A01.

Silicon-germanium alloys are established thermoelectric materials for high-temperature applications and have been successfully used in the fabrication of the thermocouples of radioisotope thermoelectric generators which provided the onboard electrical power to several US space vehicles. Recently, material-development scientists have focused attention on possible improvements in the figure of merit of alloys based on silicon-germanium through an increase in a 2o (the so-called electrical figure of merit, or power factor). In the final report is embodied the results of a program of work to develop a realistic working theoretical model of the silicon-germanium alloy systems and its use in identifying and investigating the parameters that determine the value of the electrical figure of merit.

42437 (AD-A-207117/3/XAB) **Advanced processing and properties of high-performance alloys. Technical report, 1 January-31 December 1988.** Koss, D.A. Pennsylvania State Univ., University Park, PA (USA). Dept. of Materials Science and Engineering. Apr 1989. 33p. (TR-12). Available from NTIS, PC A03/MF A01.

Progress is reviewed for a research program whose purpose is to establish a broad-based understanding of the application and consequences of advanced processing techniques, especially as they influence the strength and fracture resistance of high -performance structural alloys. While some of the research is specific to certain alloy systems, much of the program constitutes fundamental study of the deformation and fracture of engineering alloys containing processing-induced defects. Progress for the period January 1, 1988, to December 31,1988, is reviewed for the following projects within the program: the influence of porosity on low cycle fatigue, the mechanism of strain-induced void/pore linking during ductile fracture, and the processing and properties of Cu-Nb microcomposites.

42438 (AECL-8392) **POSDIP: a computer program for the evaluation of point-defect properties in metals.** Woo, C.H.; Puls, M.P. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. Nov 1985. 51p. Order Number DE89634929/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

In FORTRAN on CDC Cyber computer.

A computer program, PODSIP, designed to carry out point-defect calculations using computer simulation techniques is described. The program can be used to evaluate defect properties in any hexagonal or cubic crystalline material that can be described by means of a sensibly short-ranged pair potential. The physical basis used by PODSIP for evaluating defect energies and configurations, elastic dipole tensors, and diaelastic polarizabilities is presented. A brief account is given of the overall logical structure of PODSIP and some important programming features. One important feature is PODSIP's ability to evaluate defect properties for both their equilibrium and saddle-point configurations by means of only one program run. To test the program, a determination of the defect properties of the single vacancy and the [100] dumb-bell interstitial in copper, using an empirical pair potential, is given. Emphasis in this study is on the diaelastic polarizability of the defect in its saddle-point positions. 19 refs.

42439 (AECL-9088) **Variate generation for probabilistic fracture mechanics and fitness-for-service studies.** Walker, J.R. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 37p. Order Number DE89635532/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Atomic Energy of Canada Limited is conducting studies in Probabilistic Fracture Mechanics. These studies are being conducted as part of a fitness-for-service programme in support of CANDU reactors. The Monte Carlo analyses, which form part of the Probabilistic Fracture Mechanics studies, require that variates can be sampled

from probability density functions. Accurate pseudo-random numbers are necessary for accurate variate generation. This report details the principles of variate generation, and describes the production and testing of pseudo-random numbers. A new algorithm has been produced for the correct performance of the lattice test for the independence of pseudo-random numbers. Two new pseudo-random number generators have been produced. These generators have excellent randomness properties and can be made fully machine-independent. Versions, in FORTRAN, for VAX and CDC computers are given. Accurate and efficient algorithms for the generation of variates from the specialized probability density functions of Probabilistic Fracture Mechanics are given. 38 refs.

42440 (AECL–9382) **Are zirconia corrosion films a form of partially stabilised zirconia (PSZ)?.** Cox, B. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Mar 1987. 24p. Order Number DE89634992/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The problem of understanding the development of porosity in a zirconium oxide film still under biaxial compression is discussed. The oxide film is compared with partially stabilised zirconia (PSZ) where stress induced transformation of tetragonal zirconia has been observed to lead to microcracking of the structure. The similarities between PSZ and the thermal oxide films formed on zirconium alloys are enumerated, and an hypothesis is proposed that can both explain the penetration of pores or microcracks in oxides on Zircaloy-2 to a point very close to the oxide/metal interface, and explain the observation that such a phenomenon does not occur in oxide films on Zr-2.5%Nb. This hypothesis could be tested by laser Raman spectroscopy on oxide films during growth at elevated temperatures. 87 refs.

42441 (AECL–9386) **Residual strains in girth-welded linepipe.** MacEwen, S.R.; Holden, T.M.; Powell, B.M.; Lazor, R.B. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Jul 1987. 14p. Order Number DE89634958/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

High resolution neutron diffraction has been used to measure the axial residual strains in and adjacent to a multipass girth weld in a complete section of 914 mm (36 inches) diameter, 16 mm (5/8 inch) wall, linepipe. The experiments were carried out at the NRU reactor, Chalk River using the L3 triple-axis spectrometer. The through-wall distribution of axial residual strain was measured at 0, 4, 8, 20 and 50 mm from the weld centerline; the axial variation was determined 1, 5, 8, and 13 mm from the inside surface of the pipe wall. The results have been compared with strain gauge measurements on the weld surface and with through-wall residual stress distributions determined using the block-layering and removal technique.

42442 (CANMET–7-185-144) **Characterization and determination of surface bound hydrogen and deuterium in 1062, 4037 and 4140 steels by secondary ion mass spectrometry. Final report.** Donepudi, V.S.; McIntyre, N.S. Canada Centre for Mineral and Energy Technology, Ottawa, ON (Canada). 1986. 99p. (MICROLOG–87-01222). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

Secondary Ion Mass Spectrometry (SIMS) is a technique that is sensitive to all elements, including hydrogen isotopes. The capability of the technique for measuring hydrogen concentations in hydrogen charged steel surfaces has been assessed. The deuterium isotope was used in place of light mass-1 hydrogen (protium) because of a high background from the latter isotope in most SIMS instruments. Deuterium surface concentrations were quantified using known concentrations of the deuterium isotope implanted into the steel samples being studied. Surfaces of 1062, 4037 and 4010 steels were cathodically charged with deuterium and were analyzed by SIMS. Deuterium concentrations in the range of 1-8 atom pecent were detected on the steel surfaces. Treatment of deuterium charged samples with nitric, acetic and phosphoric (NAP) acid mixtures resulted in a significant decrease in the surface deuterium concentration. This was particularly so for 4037 steels where 90% of the deuterium was removed from the surface region by NAP treatment. Some efforts were also made to assess the effects of NAP treatment on the cathodically hydrogen charged steels. Parallel experiments wee done with the carrier gas technique for measuring bulk hydrogen concentrations. This technique showed that NAP treatment reduced the bulk hydrogen concentration in these specimens. Compared to the surface concentration of deuterium, the bulk concentration is less sensitive to NAP treatment. 16 refs., 46 figs., 10 tabs.

42443 (CONF-890820–2) **APFIM [atom probe field-ion microscope] investigations of solute clustering and precipitation in irradiated RPV [reactor pressure vessel] steels.** Burke, M.G.; Grant, S.P.; Miller, M.K. Oak Ridge National Lab., TN (USA). 1989. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 4. international symposium on environmental degradation of materials in nuclear power systems: water reactors; Jekyll Island, GA (USA); 6-10 Aug 1989. Order Number DE89015867/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

After exposure to low and intermediate fluence neutron irradiation, a variety of reactor pressure vessel (RPV) steels, including A533B-type surveillance specimens, Gundremmigen KRB-A ex-service plate, and test reactor irradiated materials, have been analyzed in the atom probe field-ion microscope (APFIM). With this instrument, it is possible to characterize the ultrafine microstructural features associated with irradiation embrittlement. The statistical significance of the solute clustering has been evaluated with the mean separation technique of Hetherington and Miller. Atom probe analysis has provided direct evidence of very diffuse phosphorus-enriched and copper-enriched atmospheres. Phosphorus appears to play a more dominant role than copper in these low fluence irradiations. 14 refs., 5 figs., 5 tabs.

42444 (CONF-8809201–5) **Unified theoretical analysis of experimental swelling data for irradiated austenitic and ferritic/martensitic alloys.** Lee, E.H.; Mansur, L.K. Oak Ridge National Lab., TN (USA). 1989. 54p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From American Institute of Mechanical Engineers meeting; 25-29 Sep 1988. Order Number DE89016159/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Swelling of austenitic and martensitic alloys, which are materials used for fusion and fission reactors, is described. A theoretical approach is used. The importance of point defects are discussed. 52 refs., 16 figs., 3 tabs. (CBS)

42445 (CONF-8811195–) **Characterization of the structure and chemistry of defects in materials: Proceedings.** Larson, B.C.; Ruehle, M.; Seidman, D.N. (eds.). Oak Ridge National Lab., TN (USA). 1988. 589p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From MRS symposium on characterization of the structure and chemistry of defects in materials; Boston, MA (USA); 28 Nov - 3 dec 1988. Order Number DE89014796/JAW. Available from NTIS, PC A25/MF A01 - OSTI; GPO Dep.

Research programs, presented at the materials research symposium, on defects in materials are presented. Major areas include: point defects, defect aggregates, and ordering; defects in nonmetals and semiconductors; atomic resolution imaging of defects; and gain boundaries, interfaces, and layered materials. Individual projects are processed separately for the data bases. (CBS)

42446 (DOE/ER/45061–T5) **Ordered structures and metastable alloys grown by OMVPE.** Stringfellow, G.B. Utah Univ., Salt Lake City, UT (USA). Coll. of Engineering. [1989]. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-84ER45061. Order Number DE89016370/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Our understanding of the thermodynamics of mixing in semiconductor solids has evolved from the purely empirical regular solution model to models based on the electron energy states in the solid, including the delta-lattice parameter (DLP) model and, more recently, first principles calculations. These models are in agreement that the enthalpy of mixing is invariably ≥ 0 for III/V and II/VI alloys, and increases with increasing difference in lattice constant for the constituent binary compounds. In terms of the simple thermochemical mixing models, this suggests the occurrence of miscibility gaps.

Solid phase immiscibility has indeed been observed in a number of systems. Nevertheless, such alloys can be grown by OMVPE, including the highly metastable alloys GaPSb and InPSb. Ordered structures have now been observed in several III/V alloy systems including the ternary systems GaAsSb, GaInP, AlInAs, AlGaAs, and GaInAs, and the quaternaries GaInAsP, GaInAsSb, and AlGaInP. In this paper, ordering in other alloy systems such as GaPSb, InPSb, InAsSb, and GaAsP will be described. An unexpected observation is that the preferred ordered structure for the ternaries GaInP, GaPSb, InAsSb, and GaAsP involves ordering along the (111) directions, forming the Cu–Pt($L1_1$) structure. This is also true of GaAsSb grown by MBE. Both the first principles calculations and simple strain energy calculations indicate that such ordered structures are more stable than the disordered solid solution, but less stable than other ordered structures. 56 refs., 4 figs., 1 tab.

42447 (DOE/ER/45184–5) **The role of grain boundary character in the environmentally-assisted integranular cracking mechanism of nickel-base alloys: Progress report, August 1, 1988–July 31, 1989.** Was, G.S. Michigan Univ., Ann Arbor, MI (USA). Dept. of Nuclear Engineering. Jul 1989. 31p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER45184. Order Number DE89015333/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Over the past year additional experimental results and more accurate modeling were obtained for the grain boundary chemistry and structure of controlled purity alloys 690 and X-750 material as a function of thermal treatment. High purity heats of Ni-30Cr-9Fe (alloy 690) and Ni-16Cr-9Fe-2.5Ti-0.7Al (alloy X-750) were prepared by the Materials Preparation Center, Ames Laboratory, Iowa State University. Each were doped with 0.03 wt % C. The material was delivered in the form of 3.05 mm rods for the convenience of transmission electron microscopy sample preparation. Due to casting defects in the alloys, the base stock materials were purified by electron beam melting before alloying to reduce the levels of any tramp elements that would form these casting defects. Chromium depletion profiling and analysis of precipitate composition were conducted in a JEOL 100CX STEM using energy dispersive x-ray analysis. Precipitate structure was determined by convergent beam electron diffraction in a JEOL 2000 FX STEM in addition to selected area diffraction in the JEOL 100 CX STEM. Computer modeling was done on a Macintosh II computer with the codes operating in the FORTRAN language. 8 refs., 12 figs., 14 tabs.

42448 (EGG-M–88375) **Selection of cask shell material.** Wells, A.H.; Thompson, T.C.; Liu, T.L.; Chuang, C.; Ball, L.W. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 10p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC07-76ID01570. (CONF-890631–63: International symposium on packaging and transporting of radioactive materials, 11-16 Jun 1989). Order Number DE89016366/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

Previous cask design experience indicates that the stress analysis and structural stability evaluation of the cask inner shell is a key factor in evaluating the adequacy of the cask's containment boundary. The yield strength of the shell material establishes the thickness required and, hence, the cask weight, which indirectly controls the cask capacity. This study concentrates on the effect of different materials and different shell thickness combinations on the cask capacity. Nuclear Assurance Corporation used the ANSYS finite element structural analysis code to perform a detailed structural analysis of an existing rail/barge cask. The cask's capacity is 31 assemblies in a burnup credit configuration. The stress results for the inner shell obtained from the ANSYS analysis are used for the buckling evaluation in accordance with the American Society of Mechanical Engineers (ASME) Code Case N-284 to determine the adequacy of the inner shell thickness. 2 refs., 1 fig., 5 tabs.

42449 (GKSS–87/E/64) **Influence of the chemical composition of RPV-steels on radiation embrittlement.** Ahlf, J.; Bellmann, D.; Schmitt, F.J.; Foehl, J. GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). 1987. 8p. (CONF-870812–: 9. biennial international conference on structural mechanics in reactor technology (SMIRT-9), 17-21 Aug 1987). Available from Offprint from Wittmann, F.H. (ed.): Structural mechanics in reactor technology. Vol. F. LWR pressure components. Balkema, Rotterdam (Netherlands), 1987, p. 353-358.

As a contribution to the research program 'Integrity of Components' a number of special melts of steel 22NiMoCr37 (corresponding to ASTM A508 cl.3) have been fabricated and investigated. These melts were originally tailored to investigate effects of chemical composition on the sensitivity to stress relief cracking during post weld heat treatment. For this reason the content of some of the residual elements was intentionally varied, and did not always meet the stringent demands of the appropriate regulatory requirements. Eight special melts similar to the German RPV steel 22NiMoCr37 (corresponding to ASTM A508 cl.3), seven of which had an intentionally high copper content (.2%) and varying phosphorus and sulfur contents, were irradiated at 290°C to a fluence of 2,5x1023 m2, E > MeV. It was shown that the irradiation induced embrittlement as determined from the 41 J Charpy shift was strongly enhanced by increasing the phosphorus and sulfur concentration, phosphorus presumably playing the main role. Comparing different correlation models for the transition temperature shift the trend curves of USNRC Reg.Guide 1.99 rev. 1 give the best correlation, however on a very conservative level. (orig./HP).

42450 (GKSS–88/E/69) **Draft EGF recommendations for determining the fracture resistance of ductile materials: EGF procedure EGF P1-87D.** Schwalbe, K.H.; Neale, B.K.; Ingham, T. GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). 1988. 13p. Available from Special print from Fatigue Fract. Eng. Mater. Struct. (1988) v. 11(6) p. 409-420.

The EGF Working Party on Fracture Mechanics Testing Standards has written a draft EGF Procedure for determining the crack growth fracture resistance of ductile materials, either in terms of the J-integral or the crack tip opening displacement. Methods are also given for deriving J and δ fracture parameters related to initiation of crack growth. The multiple specimen method is taken as the reference method. Several single specimen techniques are described in Appendices. The EGF Procedure is currently being validated by an experimental round robin. (orig.).

42451 (GKSS–89/E/3) **Prediction of load point displacement and J-integral using ETM-progress report on elastic-plastic flaw assessment methods.** Schwalbe, K.H. GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). 1989. 22p. Order Number DE89911458/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

This report presents further validation of the Engineering Treatment Model (ETM) concerning estimates of load point displacement and J-integral by means of experiments and finite element calculations on laboratory specimens. (orig.) With 9 figs.

42452 (HEDL-SA–3564) **Microstructural examination of 12% Cr martensitic stainless steel after irradiation at elevated temperatures in FFTF [Fast Flux Test Facility].** Hsu, Chen-Yih; Gelles, D.S.; Lechtenberg, T.A. Hanford Engineering Development Lab., Richland, WA (USA). Jun 1986. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76FF02170. (CONF-860605–47: 13. international symposium on the effects of radiation on materials, 23-25 Jun 1986). Order Number DE89014954/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

A remelted 12% Cr martensitic stainless steel (HT-9) has been examined by transmission electron microscopy before and after irradiation in the Materials Open Test Assembly (MOTA) of the Fast Flux Test Facility (FFTF). The irradiation temperatures were 365,420, 520, and 600°C with the fluences as high as 7.3 x 10^{22} n/cm^2 (E > 0.1 MeV) or 34 dpa. The extracted precipitates from each specimen were identified using x-ray microanalysis and selected area diffraction. The precipitates in the unirradiated condition were primarily $M_{23}C_6$ carbides, which formed at martensite lath and prior austenite grain boundaries. During irradiation at elevated temperatures, small amounts of other phases formed, which were tentatively identified as the chromium-rich α', the nickel-silicon rich G-phase, and the intermetallic Chi phase. Irradiation-induced voids were observed only in specimens irradiated at 420°C to a dose of 34 dpa; no voids were found for specimens irradiated at 365, 520, and 600°C (~11, ~34, and ~34 dpa). These results are not in agreement with previous experiments in that voids have not been reported

in this alloy at relatively high fluence level (~67 dpa) following irradiation in another fast-spectrum reactor (EBR.II). This is, however, the first observation following FFTF irradiation. The present results indicate that cavities can form in HT-9 at modest fluence levels even without significant generation of helium. Hence, the cavity formation in this class of ferritic alloys is not simply caused by helium generation but rather more complex mechanisms. 12 refs., 2 figs., 3 tabs.

42453 (IFUSP-P–766) **Hyperfine interactions and magnetic structure of $R_{1+\epsilon}Fe_4B_4$ (R=rare earth) intermetallic compounds.** Rechenberg, H.R.; Boge, M.; Jeandey, C.; Oddou, J.L.; Sanches, J.P. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Jan 1989. 11p. Order Number DE89634930/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

$R_{1+\epsilon}Fe_4B_4$ alloys order ferromagnetically at low temperatures, but Fe atoms carry no magnetic moment. Moessbauer measurements have been carried out using the ^{57}Fe, ^{155}Gd and ^{161}Dy resonances. Fe shows small transferred fields in some alloys. Strong CEF interactions are inferred from Gd and Dy data. A consistent picture of magnetic structure emerges from the analysis of combined magnetic and quadrupolar interactions. (author).

42454 (INIS-mf–11989, pp. 223) **Investigations of the corrosion of zirconium, tantalum and tantalum/niobium alloys in azeotropic nitric acid by nuclear analytical techniques.** Droste, R. (Bayer A.G., Leverkusen (Germany, F.R.)); Holm, R.; Horn, E.M.; Herpers, U.; Klas, W.; Reich, M.; Michel, R. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

42455 (INIS-SU–89, pp. 143) **Work functions for alkali metals and alloys.** Alchagirov, B.V. (Kabardino-Balkarskij Gosudarstvennyj Univ., Nal'chik (USSR)); Lazarev, V.B.; Shebzukhov, M.D. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

Short Communication

42456 (INIS-SU–98, pp. 159) **Multilayer structure mixing under by an intense ion beam effect.** Zavodchikov, V.M.; Isakov, I.F.; Kojshibaev, R.G. and others. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

Short Communication

42457 (INIS-SU–98, pp. 168) **Mutual reactions in InP an GaP monocrystals with AuGe films irradiated by argon ions.** Sargunas, V.R.; Zubauskas, G.A.; Balchajtis, G.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

Short Communication

42458 (JINR-N–5(31)-88, pp. 36-41) **Radiation hardening of zirconium after the bombardment by heavy ions and neutrons.** Didyk, A.Yu.; Malinovskij, V.; Nazarov, V.M. and others. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). In *JINR rapid communications. Collection of papers.* Order Number DE89012200/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

The radiation hardening of zirconium after the bombardment by Ne ions (E_i=230 MeV) and by neutrons (E_n>0,1 MeV) under the same conditions was investigated. The dose dependence of the yield stress change $\Delta_{\sigma(sub0.2)}$ was measured. It is shown that the dose dependences are identical in both cases, but a certain effect of the hardening after neutron bombardment is achieved at a dose 10 times smaller than in the case of Ne bombardment. 15 refs.; 2 figs.

42459 (Juel–2211) **The influence of carbide precipitation on the creep rupture behaviour of high temperature alloys.** Gracht, R. von der; Ennis, P.J.; Czyrska-Filemonowicz, A.; Quadakkers, W.J.; Schuster, H; Nickel, H. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe; Technische Hochschule Aachen (Germany, F.R.). Jul 1988. 139p. (In German). Available from Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek.

The effect of carbon content on the creep behaviour of Ni Cr22 Co12 Mo (INCONEL 617) and X10 NiCrAlTi 3220H (INCOLOY 800H) has been investigated at 850 and 950°C. In addition to the examination of heats of different carbon content, commercial heats (carbon content 0.08 wt.-%) were carburized before or during testing. Tests on the commercial alloys in a decarburizing atmosphere were also carried out. Pre-carburized specimens exhibited a significantly higher creep rupture strength than solution treated specimens and specimens tested in a carburizing atmosphere. The tests on alloys of different initial carbon contents showed that the secondary creep rate decreased with increasing carbon content. Specimen which were tested in a decarburizing atmosphere exhibited a very high creep rate after only a few hours of testing. The rupture times for specimens tested in the decarburizing atmosphere were an order of magnitude shorter than those of specimens tested in air or in carburizing atmospheres at the same temperature and stress. The very low creep rupture strength of the decarburized material is attributed to the absence of grain boundary carbides, with the result that grain boundary sliding was enhanced. Consequently the rapid formation of grain boundary pores and cracks occurred. (orig.).

42460 (KFK–4569) **Life time calculations by means of the life fraction rule for material 1.4948 in the temperature range between 550°C and 650°C.** Baumgaertner, W.; Bocek, M.; Pfeifenroth, M.; Scheibe, W.; Schmitt, R. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter. May 1989. 34p. (In German). Order Number DE89796041/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report describes the influence of temperature and hold-time upon the low-cycle fatigue-behaviour of material 1.4948 in the temperature range of 450 up to 850°C. It is shown that stress-relaxation behaviour during hold-time is life determining. Furthermore the reduction of number of cycles to fracture N_f depends upon temperature. The Life Fraction Rule (LFR) is presented as a damage model which has been applied for life time calculations of hold-time tests for 550 and 650°C. The results show a rather good agreement between calculated N_f-values and experimental data. (orig.).

42461 (KFK–4575) **Propagation of semi-elliptical surface cracks in ferritic and austenitic steel plates under thermal cyclic loading.** Bethge, K. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau. May 1989. 154p. (In German). Order Number DE89796040/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Theoretical and experimental investigations of crack growth under thermal and thermomechanical fatigue loading are presented. The experiments were performed with a ferritic reactor pressure vessel steel 20 MnMoNi 5 5 and an austenitic stainless steel X6 CrNi 18 11. A plate containing a semi-elliptical surface crack is heated up to a homogeneous temperature and cyclically cooled down by a jet of cold water. On the basis of linear elastic fracture mechanics stress-intensity factors are calculated with the weight function method. The prediction of crack growth under thermal fatigue loading using data from mechanical fatigue tests is compared with the experimental result. (orig.).

42462 (LA-UR–89-2572) **Shock recovery experiments: An assessment.** Gray, G.T. III. Los Alamos National Lab., NM (USA). 1989. 32p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890812–4: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89015279/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Systematic shock recovery experiments, in which microstructural and mechanical property effects are characterized quantitatively, constitute an important means of increasing our understanding of shock processes. Through studies of the effects of variations in metallurgical and shock loading parameters on structure/property relationships, the micromechanisms of shock deformation, and how they differ from conventional strain rate processes, are beginning to emerge. This paper will highlight the state-of-the-art in shock recovery of metallic and ceramic materials. Techniques will be described which are utilized to "soft" recover shock-loaded metallic samples possessing low residual strain; crucial to accurate "post-mortem" metallurgical investigations of the influence of shock loading on material behavior. Illustrations of the influence of shock assembly design on the structure/property relationships in shock-recovered copper samples including such issues as residual strain and contact stresses, and their consequences are discussed. Shock recovery techniques used on brittle materials will be reviewed and discussed in light of recent experimental results. Finally, shock recovery structure/property results and VISAR data on the α–ω shock-induced phase transition in titanium will be used to illustrate the beneficial link between shock recovery and "real-time" shock data. 26 refs., 3 figs.

42463 (LBL–27221) **Cryogenic mechanical properties of low density superplastic aluminum alloys.** Verzasconi, S.L. Lawrence Berkeley Lab., CA (USA). May 1989. 75p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89015347/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Two alloy systems, mainly Al-Li-Cu and Al-Mg-Sc, were studied in this work. Both of these systems have been shown to be superplastically formable in the conditions chosen, and both provide a significant density reduction over a currently used aluminum cryogenic fuel tankage material, 2219. The Al-Mg-Sc alloy provides over 50 percent of the density reduction of 2090 over 2219. In addition to lower density, Al-Li alloys have a higher elastic modulus (stiffness) than conventional aerospace alloys. The main purpose of this work is to characterize the cryogenic strength and toughness of several Al-Cu-Li and Al-Mg-Sc alloys. In addition, the microstructures and fracture surfaces are characterized and related to these properties where possible. 43 refs.

42464 (MLM–3601-OP) **A new technique for tritium imaging and profiling using a computer aided–video enhanced microscope system for metallographic analysis.** Downs, G.L. EG and G Mound Applied Technologies, Miamisburg, OH (USA). 1989. 21p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-88DP43495. (CONF-8907116–2: 22. annual international Metallographic Society meeting, 23 Jul 1989). Order Number DE89015381/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

Recent advances in image enhancement and image processing have made ultra-low-light microscopy a reality. Currently available instrumentation allows imaging of "individual" photons with a tremendous dynamic range of one to 10^9 photons/mm^2/sec. This capability allows for the development of tritium imaging techniques based on different basic principles than previously employed. Previous autoradiographic techniques for this purpose used photographic emulsions which are chemically reactive with many metals and for good resolution required in-situ processing in chemical solutions which can also chemically affect the samples or emulsion characteristics. The new technique makes use of optically transparent thin films of relatively chemically inert scintillating compounds applied to metallographically prepared samples. The light given off by these scintillating compounds can now be imaged and quantified using the new Video Intensified Microscope (VIM) System. This allows the location of the tritium to be imaged as well as the corresponding microstructure. In addition, special containers have been designed and built to allow highly radioactive or pyrophoric samples with high levels of off-gassing to be evaluated. 5 refs., 10 figs.

42465 (MRC/IT–UP-M-502) **An investigation of the corrosion fatigue behaviour magnetic metallic glasses. Final report.** Manitoba Research Council, Winnipeg, MB (Canada). Industrial Technology Centre. 1986. 45p. (MICROLOG–87-02203). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

Because of their unique structure, metallic glasses show unusual physical properties. Amorphous alloys containing iron can be mechanically very hard yet some are easily magnetised and demagnetised with little loss of energy. Many applications of metallic glasses are thus found in electromagnetic devices. Most electromagnetic devices such as transformers, sensors and switches are exposed to vibration and fatigue under corrosive environments in real-life working conditions. In this research commercially available iron based metallic glasses, Metglas 2605-S2, 2605-SC and 2826-MB, were studied for their tensile behavior and fatigue strength in air and in 3% solutions of sulfuric acid and of NaCl. As-received ribbons (25 mm wide) were evaluated and straight length samples were used for both tensile and fatigue testing. Attempts to use scissors or electrical discharge machining for fabrication caused excessive damage. Sulfuric acid solution severly corroded the 2605-S2 and 2605-SC and therefore affected the tensile strength, whereas 2826-MB was not affected at all. In fatigue tests, S-N curves (showing stress ratio vs number of cycles to failure) similar to those of crystalline alloys were obtained with distinct fatigue limits for all alloys. Fatigue strength of 2826-MB was found to be superior to the other alloys in all environments. Alloy 2605-SC and 2605-S2 had significant loss of fatigue strength in H_2SO_4 solution, attributed to severe corrosion. The fracture surfaces contained typical vein pattern and striation markings; however, no distinct single fracture initiation point could be located in these ribbons. Some unique fracture features were also noticed under scanning electron microscopy. 14 refs 21 figs 5 tabs

42466 (NOVA–8609) **Pulsed gas metal arc welding of thick-section steels for low temperature applications.** Dorling, D.V.; Huntley, R.M.; Geerligs. J.; Rothwell, A.B. Nova, an Alberta Corp., AB (Canada). 1986. 188p. (MICROLOG–87-05175). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

For the economical construction of offshore structures and pipelines and of Arctic vessels, a clear need exists for welding processes which are capable of depositing weld metal of high integrity and toughness, and which offer significantly improved productivity, relative to conventional shielded metal arc welding (SMAW). This report examines the potential of mechanized, pulsed gas metal arc welding (GMAW). The pulsed mode, by extending controlled opn-arc conditions to lower mean currents, can circumvent difficulties with the previously known short-circuiting mode, and in addition allows the use of shielding gases having very low oxygen potential. This report describes studies of metal transfer, burn-off and fusion characteristics, using a range of wire and shielding gas combinations, which have led to the establishment of optimum pulse structure and synergic logic. Power source characteristics have been modified so that excellent arc stability and metal transfer characteristics are maintained for all-position groove welds. Pulsed GMAW procedures have been established which present considerable productivity advantages, relative to SMAW. Test panels produced in manganese steel plate indicated the excellent capability of the process for control of weld metal composition in low oxygen-potential gases. Exceptional Charpy toughness was achieved in the best of the deposits, but crack tip opening displacement toughness at -45^{0}C was unsatisfactory for all but one of the wires examined. Fracture initiation appeared to be controlled by the behaviour of the root region, however, and it is likely that this problem can be overcome. 25 refs., 47 figs., 58 tabs.

42467 (PB–89-863450/XAB) **Neodymium-iron-boron (Nd-Fe-B) permanent magnets. January 1984-May 1989 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1984-May**

1989. National Technical Information Service, Springfield, VA (USA). Jun 1989. 198p. Available from NTISPC N01/MF N01.

Supersedes PB–88-864012.

This bibliography contains citations concerning the development, fabrication, and applications of neodymium-iron-boron (Nd-Fe-B) permanent magnets. Topics include magnetization and aging of magnets, crystal structure and magnetic properties, coercivity of Nd-Fe-B magnets, magnetic hardening mechanism, and high- and low-temperature properties of Nd-Fe-B magnets. Applications of Nd-Fe-B permanent magnets in electrical machines, magnetomechanical devices, and medical and dental devices are presented. (This updated bibliography contains 348 citations, 144 of which are new entries to the previous edition.)

42468 (ST–87R002) **Develop and evaluat of the gas metal arc welding/submerged arc welding process for improved weld properties. Final report.** Muir, D.A.; Fortier, R.M. Stelco, Inc., Hamilton, ON (Canada). 1987. 57p. (MICROLOG–87-05171). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

The Stelform plate-end welding operation performs unacceptably in the manufacture of thick line pipe (>0.65 in). The welding process stability breaks down as plate thickness, or heat input increases. This results in weld defect frequencies that are too high and the intermittent occurrence of solidification cracking at the joint ends. A new plate-end welding process is needed to manufacture the full thickness range of Stelform line pipe. A recently-developed but not commercialized process, Gas Metal Arc-Submerged Arc Welding (GMA-SAW), is considered the best candidate. A literature search was performed and a computer model to predict GMA-SAW welding procedures was developed. Experimental stations for high current gas metal arc welding (GMAW) and GMA-SAW welding trials were constructed. GMAW process equipment, materials, procedures, and weld characteristics, including those of preliminary GMA-SAW welds, were investigated. It is concluded that GMA-SAW can be applied to plate-end welding for thick skelp in the Stelform line pipe manufacture. The process operates stably with single or multiple electrode gas metal arc welding in high current regimes with good weld quality tolerances to arc current, voltage, and joint fit-up gap variations. The process decreases SAW heat input by 15-25% which improves bead shape and reduces sensitivity to solidification cracking. The process also produces weld metal and heat affected zone fracture toughness at least equuivalent to the resent two-wire SAW process with potential for improvement as the consumables and procedures are refined. 16 refs., 39 figs., 24 tabs.

42469 (VTT-TUTK–589) **Corrosion of high-alloy stainless steels in the marine environment.** Varjonen, O. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Mar 1989. 58p. Order Number DE89902334/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

High-alloyed stainless steels have been developed by increasing the amount of chromium up to 25% and that of molybdenum up to 3.0% in the stainless steels. They are widely applied in the seawater environment where the most important corrosion types are crevice corrosion and galvanic corrosion possibly induced by microbial slime layer formation. In this study the microbial slime layer of the high-alloyed stainless steels is investigated by transmission electron microscope. The corrosion potential of the alloys is measured during the sea-water exposure. Based on the above experiments the corrosion potential of the alloys is predominantly increased by the adherent slime layer. The bacterial layer of the alloys consists of several microbial organisms and by-deposited metal-ions or metallic compounds.

42470 (ZJE–281) **Analysis of the applicability of fracture mechanics on the basis of large scale specimen testing.** Brumovsky, M.; Polachova, H.; Sulc, J.; Anikovskij, V.; Dragunov, Y.; Rivkin, E.; Filatov, V. Skoda, Plzen (Czechoslovakia). 1988. 18p. Order Number DE89634959/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The verification is dealt with of fracture mechanics calculations for WWER reactor pressure vessels by large scale model testing performed on the large testing machine ZZ 8000 (maximum load of 80 MN) in the Skoda Concern. The results of testing a large set of large scale test specimens with surface crack-type defects are presented. The nominal thickness of the specimens was 150 mm with defect depths between 15 and 100 mm, the testing temperature varying between -30 and +80 degC (i.e., in the temperature interval of T_{ko} ±50 degC). Specimens with a scale of 1:8 and 1:12 were also tested, as well as standard (CT and TPB) specimens. Comparisons of results of testing and calculations suggest some conservatism of calculations (especially for small defects) based on Linear Elastic Fracture Mechanics, according to the Nuclear Reactor Pressure Vessel Codes which use the fracture mechanics values from J_{IC} testing. On the basis of large scale tests the "Defect Analysis Diagram" was constructed and recommended for brittle fracture assessment of reactor pressure vessels. (author). 7 figs., 2 tabs., 3 refs.

42471 Radiation-induced changes in microstructure: ASTM 13th international symposium (Part I). ASTM special technical publication 955. Gavner, F.A.; Packan, N.H.; Kumar, A.S. 901p. ASTM, Philadelphia, PA (1987). (CONF-860605–: 13. international symposium on the effects of radiation on materials, Seattle, WA (USA), 23-25 Jun 1986).

This book contains over 50 selections. Some of the titles are: Vacancy properties during irradiation with high energy particles; effect of swelling in Inconel 600 on the performance of FFTF reflector assemblies; Swelling of 316 Stainless steel and D9 cladding in FFTF; Oxygen effects on void stabilization in stainless steel; and Gas-bubble growth mechanisms in the analysis of metal fuel swelling.

42472 Room temperature tensile ductility in polycrystalline B2 NiAl. Hahn, K.H. (Dept. of Materials Science and Engineering, Case Western Reserve Univ., Cleveland, OH (US)); Vedula, K. *Scripta Metallurgica (USA)*, 23(1): 7-12 (Jan 1989).

The lack of tensile ductility in polycrystalline B2 NiAl has been attributed to the lack of five independent slip systems to satisfy von Mises' criterion for compatibility in polycrystalline deformation. Single crystal studies (4-10) show that the deformation of this alloy is highly anisotropic. The non-<100> oriented crystals (soft orientations) are much more ductile than the <100> oriented crystals (hard orientations) at low temperature. This is because the critical resolved shear stress required to activate primary slip of the <100> type is much less than that required to activate other slip systems as the <111> type. All orientations possess considerable ductility even when tested in tension at intermediate temperatures (>–673K). There is general agreement that for non-<100> oriented crystals, deformation involves (100) <001> and {110} <100> slip systems at low as well as intermediate temperatures. The behavior of <100> oriented crystals is less clear and conflicting data exist: <111> slip direction with {123{right_brace} and {112} slip planes have been observed at low temperatures; while <111>, <110> and <100> directions have been reported for high temperature deformation. The number of slip systems which operate if only the {110}<100> slip occurs is insufficient for von Mises's criterion for polycrystalline deformation. In compression, ductility is observed since there is no driving force to open cracks that must form at grain boundaries due to the lack of sufficient slip systems. In tension, however, the applied stress acts directly to open the crack and failure may occur before further deformation can take place. On the other hand, if <111> slip is possible (as in the case of disordered BCC alloys as well as some other compounds), there are enough slip systems of the type {110} <111>, to satisfy von Mise's criterion and lead to polycrystalline tensile ductility.

42473 Transient and intermittent crack growth during embrittlement of 7075-T651 aluminum by mercury. Liu, Y. (9506490); Hoagland, R.G. *Scripta Metallurgica (USA)*, 23(3): 339-344 (Mar 1989).

This paper presents some results which show intermittent and transient crack growth behavior of a high strength aluminum alloy embrittled by liquid mercury. Run-arrest-run type of cracking behavior resulted in "n" and "m"-shaped curves on the crack velocity (da/dt) vs. stress intensity (K) diagram. While variations in oxygen activity in the crack tip environment may play a role in producing non-unique v-K behavior, the results reported here suggest that formation and rupture of ligaments during crack extension may also be at work in a way that causes the stress intensity associated with the

field local to the crack tip (K_{tip}) to vary stochastically as the crack extends.

42474 On grain boundary disorder and the tensile ductility of polycrystalline ordered alloys. Baker, I. (2072000); Schulson, E.M. *Scripta Metallurgica (USA)*, 23(3): 345-348 (Mar 1989).

Uniform, arbitrary and volume-conserving plastic deformation of polycrystalline materials requires five independent deformation modes. Where deformation is not uniform, which may be the rule rather than the exception, the requirement may be relaxed. The purpose of this note is to suggest that the tensile ductility of polycrystalline, long-range ordered alloys may require additionally that the grain boundary region be, at least, partially disordered.

42475 Tensile properties of tungsten-3.6% rhenium-0.4% hafnium carbide above 0.5 T_m. Luo, A. (9503464); Jacobson, D.L.; Shin, K.S. *Scripta Metallurgica (USA)*, 23(3): 397-400 (Mar 1989).

In recent years, there has been a renewal of interest in the development of tungsten-base alloys and fibers as future aerospace propulsion and space power systems place over increasing demands on materials with high-temperature capability. For example, tungsten-base alloys are expected to be used as emitter materials in a future space power system and tungsten fiber-reinforced composites are being developed for future aerospace systems. Among various alloying elements for tungsten, rhenium has been found to be one of the most effective alloying elements because the addition of rhenium to tungsten increases not only high-temperature strength but low-temperature ductility. It has been reported that the optimum concentration of rhenium in tungsten is about 4 at.% or greater than 20 at.% to provide optimum ductilizing effect. In order to improve high-temperature strength, second-phase strengthening has also been utilized in the development of tungsten-base alloys. Among various potential second-phase particles, hafnium carbide (HfC) was found to be one of the most effective particles to improve high-temperature strength of tungsten because of its high melting temperature and thermodynamic stability. The main objective of the present paper is to report the tensile properties of a W-3.6 at.% Re-0.4 mol % HfC alloy for a wide temperature range above 0.5 T_m (melting temperature in Kelvin) and examine the strengthening effect of HfC.

42476 The influence of hydrogen on the development of localized plastic deformation in internally nitrided single crystals of iron. Deve, H.E. (0947000); Asaro, R.J.; Moody, N.R. *Scripta Metallurgica (USA)*, 23(3): 389-396 (Mar 1989).

It is well known that hydrogen can severely reduce the ductility and toughness of iron and ferrous alloys. Interface embrittlement effects, possibly through reductions in the cohesion of interfaces, and hydrogen induced microstructural damage through, for example, microvoid formation, are documented mechanisms. On the other hand, it has been reported that dissolved hydrogen affects the plastic flow process itself, through interactions with dislocations, and this appears to promote localized plastic deformation which in turn leads to fracture. The purpose of the present study was to make direct use of these background studies to learn more about the possible influences of hydrogen on the localization process. The authors' procedure was to experimentally observe the influence of hydrogen on the deformation and shear band process in ductile single crystals of internally nitrided Fe-Ti-Mn alloys. Dislocation structures involved in the localization process, along with the evolution of stress levels and strain hardening rates as shear bands formed, were documented. These crystals thus offered a good opportunity to study how hydrogen dissolved in this ferrous alloy lattice would influence the development of already well characterized dislocation structures and localization processes. The experiments carried out in the present work essentially paralleled those conducted previously, where untested crystals from the same material were hydrogen charged as described below. They were subjected to similar mechanical tests and metallographic and electron microscopy study.

42477 Fractographic finger printing of proton-irradiation-induced disordering and amorphization of intermetallic compounds. Cheng, J. (Department of Materials Science and Engineering, University of California, Los Angeles, California 90024 (US)); Yuan, M.; Wagner, C. N. J.; Ardell, A. J. *Journal of Materials Research (USA)*, 4(3): 565-578 (May 1989).

The intermetallic compounds NiTi, $NiTi_2$, CuZr, $CuTi_2$, and Zr_3Al were irradiated by 2 MeV protons at various temperatures between –175 °C and –44 °C to a fluence of 1.9×10^{22} H^+/m^2. Transmission electron microscopy, electron diffraction, and x-ray diffraction were used to evaluate the extents of disordering and amorphization induced by irradiation in the samples. Both phenomena progressed to varying extents in the five compounds, depending on the irradiation temperature and dose. It was observed that the C-A transition began before the degree of long-range order was reduced significantly, and that the amorphous phase nucleated homogeneously throughout the crystalline matrix. A major finding of the current investigation is that the technique of scanning electron fractography provides a useful correlation between the features of the fractured surfaces and the microstructural alterations induced by the proton irradiations. When amorphization is complete the fracture surfaces are either featureless (e.g., $NiTi_2$) or contain branching features resembling river patterns. In some cases (especially in CuZr) these are similar to the markings seen on the surface of fractured amorphous ribbons produced by melt-spinning. In general, however, there is not a particularly good correlation between the features on the fracture surfaces of the irradiated and melt-spun ribbons. When the microstructure consists of amorphous regions embedded in a partially disordered crystalline matrix, there is consierable evidence for irradiation-induced ductility. In such cases, exemplified by the results on NiTi and Zr_3Al, the fracture surfaces contain dimples, characteristic of ductile fracture, suggesting that disordering promotes ductility.

42478 Molecular dynamics simulation of displacement cascades in Cu and Ni: Thermal spike behavior. de la Rubia, T. D. (Department of Materials Science and Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801 (US)); Averback, R. S.; Hsieh, H.; Benedek, R. *Journal of Materials Research (USA)*, 4(3): 579-586 (May 1989). DOE Contract AC02-76ER01198;W-31-109-ENG-38.

Molecular dynamics simulations of energetic displacement cascades in Cu and Ni were performed with primary-knock-on-atom (PKA) energies up to 5 keV. The interatomic forces were represented by the Gibson II (Cu) and the Johnson-Erginsoy (Ni) potentials. Our results indicate that the primary state of damage produced by displacement cascades is controlled basically by two phenomena: replacement collision sequences during the ballistic phase, and melting and resolidification during the thermal spike. The thermal-spike phase is of longer duration and has a more marked effect in Cu than in Ni. Results for atomic mixing, defect production, and defect clustering are presented and compared with experiment. Simulations of "heat spikes" in these metals suggest a model for "cascade collapse" based on the regrowth kinetics of the molten cascade core.

42479 Effect of surface roughening on liquid-solid interface velocity. Richards, P. M. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800 (US)). *Journal of Materials Research (USA)*, 4(3): 607-611 (May 1989). DOE Contract AC04-76DP00789.

The difference in density between liquid and solid is shown to be altered at the interface of a rough surface. Since it has been argued previously by author that density difference plays a major role in interface velocity, I conclude that the rough (100) surface of silicon can have both a larger slope and less asymmetry in the freezing-melting velocity versus temperature relation than does the smooth (111) surface. This may provide partial explanation for some recent experimental results and apparent controversy.

42480 Metastable supersaturated solutions of nitrogen in rapidly-solidified silicon. Stein, H. J. (Sandia National Laboratories, Albuquerque, New Mexico 87185 (US)); Peercy, P. S.; Hills, C. R. *Journal of Materials Research (USA)*, 4(3): 616-622 (May 1989). DOE Contract AC04-76DP00789.

The depth distribution, chemical bonding, and electrical behavior of N quenched into Si by pulsed laser-induced melting have been investigated by secondary ion mass spectroscopy, infrared (ir) absorption, transmission electron microscopy (TEM), and electrical conductivity. The results demonstrate that laser-induced melting of N-implanted layers provides access to a useful range of otherwise

inaccessible conditions for the study of N in Si. Nitrogen concentrations four orders of magnitude above equilibrium solid solubility are retained in implanted layers with limited diffusion during laser-induced melt and rapid solidification. The N is incorporated predominantly as N-N pairs bonded to Si, similar to the bonding configuration for equilibrium concentrations introduced during ingot growth. Formation of Si_xN_y clusters is suggested to explain ir absorption bands, features in TEM, and shallow donor activity observed after furnace annealing near 750 °C. These cluster effects are removed by a melt/solidification sequence which restores the N to N-N pair centers together with a small fraction of off-center substitutional N.

42481 The generalized Lewis acid-base titration of palladium and niobium. Cima, M. (9501197); Brewer, L. *Metallurgical Transactions, [Section] B: Process Metallurgy (USA),* 19B(6): 893-918 (Dec 1988).

The high thermodynamic stability of alloys composed of platinum group metals and group IVB and VB metals has been explained by an electronic interaction analogous to the Lewis acid-base concept for nontransition elements. The analogy is further demonstrated by the titration of palladium by addition of niobium. The activity of niobium in solid palladium was measured as a function of concentration by solid-state galvanic cells and study of the ternary oxide phase diagram. The galvanic cells were of the Pt/NbO_2, $Nb_2O_{4.8}$/ YDT/NbO_y, $Nb_{(Pd)}/Pt$ where the solid electrolyte is yttria-doped thoria (YDT). Ternary phase diagrams for the Pd-Nb-O and Rh-Nb-O systems were obtained by characterizing samples equilibrated at 1000^0C. The phase relationships found in the ternary diagrams were also used to derive thermochemical data for the alloys. Thermochemical quantities for other acid-base stabilized alloys such as Nb-Rh, Ti-Pd, and Ti-Rh were also measured.

42482 Residual stresses in annealed zircaloy. Tome, C. (Instituto de Fisica Rosario, UNR, Av. Pellegrini 250, 2000 Rosario (AR)); Faber, J.; MacEwen, S.R. *Acta Metallurgica (USA),* 37(3): 979-1006 (Mar 1989).

Neutron diffraction has been used to measure the lattice constants of single crystal and rod-textured polycrystalline Zircaloy-2 in the temperature range 300-900 K. While the single crystal remains strain-free during heating or cooling, large residual grain-interaction strains occur in the polycrystalline sample as the result of compatibility being maintained among grains with anisotropic thermal expansion coefficients. These residual thermal strains have been determined as a function of temperature from the difference between the single and polycrystal lattice constants. Analysis of the data has been done using a polycrystalline deformation model, QUEST, which accounts for anisotropic elasticity, plasticity and thermal expansion, and for crystallographic texture of the sample. It is found that slow cooling from 900 K introduces residual stresses of the order of 100 MPa in the polycrystalline sample. The calculations demonstrate that these residual stresses can explain not only the difference in the proportional limits in tension and compression (strength differential) but also differences in the initial work hardening behaviour when Zircaloy-2 is deformed in tension or compression.

42483 Reexamination of the surface-plasma-wave technique for determining the dielectric constant and thickness of metal films. Robertson, W. M. (Material Science Division, Argonne National Laboratory, Argonne, Illinois 60439 (US)); Fullerton, E. *Journal of the Optical Society of America B: Optical Physics (USA),* 6(8): 1584-1589 (Aug 1989). DOE Contract W-31-109-ENG-38;FG03-87ER45332.

The effect of surface plasmon generation on the reflectivity of thin metal films in attenuated-total-reflection prism configurations has been described as a means of determining the film dielectric function and thickness. Although this technique is capable of yielding accurate values for the film parameters with relatively simple equipment, there is an ambiguity in fitting to the measured reflectivity data. Previous research had shown that the ambiguity could be removed by further reflectivity measurements with different conditions; however, we find that this is not necessarily true. We describe the conditions under which a unique determination of the film parameters is ensured and demonstrate that even with ambiguous results the true solution can usually be determined by a supplementary optical measurement.

42484 Rate-dependent plasticity of copper and stainless steel under shock compression. Tonks, D. L. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545 (US)). *Journal of Applied Physics (USA),* 66(5): 1951-1960 (1 Sep 1989).

Experimental copper and stainless-steel particle velocity profiles are analyzed to determine the plastic strain, plastic strain rate, and deviatoric stress through the shock front. A steady-wave shock analysis is used, together with a numerical characteristics-code calculation to correct for reflections created when the steady wave passes through the sample-window interface. The results are well represented by power-law relations giving the plastic strain rate as powers of the deviatoric stress and plastic strain. The effects of the sample-window interface are found to be minor for windows closely matched in impedance to the sample. The effects of the window on the strain-rate relation are appreciable only near peak compression.

42485 Origin of the supermodulus effect in metallic superlattices. Wolf, D. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439 (US)); Lutsko, J. F. *Journal of Applied Physics (USA),* 66(5): 1961-1964 (1 Sep 1989). DOE Contract W-31109-ENG-38.

We suggest that the maximum in Young's and the biaxial modulus observed for composition-modulated metallic superlattices arises from the same physical causes as the minimum observed in the shear modulus, namely the mutual attraction between the interfaces. We also suggest that anomalies similar to those in the elastic moduli do not exist in the elastic constants.

42486 Performance of multilayers in intense synchrotron x-ray beams. Ziegler, E. (European Synchrotron Radiation Facility, Boite Postale 220, 38043 Grenoble Cedex, France (FR)); Lepetre, Y.; Joksch, S.; Saile, V.; Mourikis, S.; Viccaro, P. J.; Rolland, G.; Laugier, F. *Review of Scientific Instruments (USA),* 60(7): 1999-2002 (Jul 1989).

The use of multilayer reflectors under intense synchroton x-ray beams requires to develop a new generation of multilayered materials that can withstand a high-power load in excess of 100 W/mm^2. Multilayers with the high-Z layer consisting either of a pure element or of compounds such as carbides, nitrides, or silicides have been produced. Because the fabrication conditions are not yet optimized, thin films with satisfactory layer were not obtained leading to poor reflectivities. Such multilayers have been both thermally annealed in a furnace and exposed to a synchrotron beam with a power density of about 1 W/mm^2. The resulting damage ranges from the total destruction of the layering to a reduction of the reflectivity by typically 40%–60%. In some cases an only 1%–15% loss in reflectivity has been observed.

42487 Chemistry of polar intermetallic compounds. Study of two Zr_5Sb_3 phases, hosts for a diverse interstitial chemistry. Garcia, E. (Iowa State Univ., Ames (USA)); Corbett, J.D. *Inorganic Chemistry (USA),* 27(13): 2353-2359 (29 Jun 1988). DOE Contract W-7405-ENG-82.

A variety of synthesis routes, some phase properties, and two single-crystal x-ray studies have established something of the nature of the Zr-Sb system in the neighborhood of 65 atom % zirconium. Samples prepared by vapor-phase transport or by annealing either elemental powders or arc-melted products at 1000-1100°C yield the Mn_5Si_3 form of Zr_5Sb_{3+x}. This is true binary phase that is nonstoichiometric over the range of $0.0_0 \leq x \leq 0.4_2$. Study of a single crystal with x = 0.16 (1) from an arc-melted sample has established that the extra antimony in this structure is bonded in an interstitial site in the center of a chain of confacial zirconium octahedra (space group $P6_3/mcm$, Z = 2, a = 8.4267 (5) Å, c = 5.7856 (6) Å, R = 2.7%, R_w = 3.4%). Many other atoms may also be bound at this site. Binary Zr-Sb samples in the range $0 \leq x \leq \approx 0.2$ melt incongruently to form the foregoing phase plus a second, new, high-temperature, stoichiometric form of Zr_5Sb_3 in the Y_5Bi_3 structure (space group Pnma, Z = 4, a = 7.465 (1) Å, b = 8.801 (1) Å, c = 10.865 (2) Å, R = 2.8%, R_w = 2.9%). The two structure types are further described and compared. 22 references, 6 figures, 5 tables.

3602 Ceramics, Cermets, and Refractories

Refer also to citation(s) 41483, 42015, 42269, 42428, 42445, 42462, 42475, 42481, 42598, 42788, 42892, 42904, 42924, 42927, 44012, 44132, 44149, 44150, 44151, 44152, 44163, 44164, 44165, 44166, 44169, 44289

42488 (AD-A–205321/3/XAB) **High-temperature ceramic superconductors. Quarterly progress report No. 2, 1 October-31 December 1988.** Mazdiyasni, K.S.; Chen, K.C.; McQuillan, B.W.; Montgomery, F.C.; Tsai, P. General Atomics, San Diego, CA (USA). 6 Jan 1989. 29p. Available from NTIS, PC A03/MF A01.

This program is divided into six tasks: (1) Metal alkoxide synthesis and processing, (2) Microstructural evaluation and property measurement, (3) Electrical and magnetic-property measurement, (4) Superconductor ceramic processing, (5) Component fabrication and demonstration, and (6) Reporting.

42489 (AD-A–205430/2/XAB) **NDE (nondestructive evaluation) of structural ceramics using neutron radiography.** Antal, J.J.; Marotta, A.S.; Corbin, N.D.; Pujari, V.K. Army Materials Research Agency, Watertown, MA (USA). Materials Technology Lab. 1987. 18p. (MTL-TR–89-4). Available from NTIS, PC A03/MF A01.

Pub. in Proceedings of Symposium on Nondestructive Evaluation (16th), 241-251(1987).

The use of ceramic materials as structural components is a rapidly advancing technology at present. Ceramics can withstand the stresses of environments beyond those commonly endured by metallic materials. It is generally believed that past difficulties with the application of ceramics may be obviated with careful selection of starting materials and constant attention to processing variables. The authors have been exploring the use of neutron radiography as an NDE tool for the examination of green and fired ceramic bodies to assess the flaw population, particularly in the early stages of processing. Here, they illustrate the use of neutron radiography for the detection of spherical voids, cracks, and binder dispersion in ceramic bodies and illustrate how simple densitometric equipment is able to map out very useful mass density variations in ceramics, even those which cannot be discerned by a visual inspection of film images.

42490 (AD-A–206003/6/XAB) **Recent magnetic studies of complex metal hydrides.** Wallace, W.E.; Pourarian, F.; Pedziwiatr, A.T.; Boltich, E.B. Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Metallurgical Engineering and Materials Science. 1987. 15p. (TR–426). Available from NTIS, PC A03/MF A01.

Pub. in Jnl. of the Less-Common Metals, Vol. 130, 33-46(1987).

The electronic characteristics of intermetallic compounds are significantly altered when they are hydrogenated. This is reflected in the change of their magnetic properties. Various effects are noted such as the conversion of Pauli paramagnets into ferrimagnets, conversion of ferrimagnets into antiferromagnets, enhancement of ferromagnetism, alteration of magnetic anisotropy, development of spin-glass structures, suppression of conductivity, and suppression of valence fluctuations. Of particular interest is the enhancement of the iron moment and the increase of the magnetic-ordering temperature in rare earth-iron compounds by hydrogenation.

42491 (AD-A–206260/2/XAB) **X-ray photoelectron spectroscopy study of samples in the Y-Ba-Cu-O system. Interim report, July 1987-September 1988.** Aprigliano, L.F.; Friedman, B.; Stockhausen, R.J. David Taylor Research Center, Bethesda, MD (USA). Ship Materials Engineering Dept. Oct 1988. 39p. (DTRC/SME–88/74). Available from NTIS, PC A03/MF A01.

Superconducting ceramics that have critical temperatures which exceed the boiling point of liquid nitrogen (77 K) have been discovered. Preliminary studies both in the United States and Japan indicate that the superconducting properties of these ceramics can degrade with exposure to water vapor during processing. X-ray photoelectron spectroscopy (XPS) is a possible method with which to study this problem. The goal of this research was to determine if there are features in the XPS spectra of these ceramics that a spectrometer with non-monochromatic radiation can use to study this reaction. As the first step in this determination, it was necessary to ascertain the extent to which this method can discriminate between the ceramic superconductor, $YBa_2Cu_3O_7$, and a poorly superconducting two-phase sample, ($YBa_2Cu_3O_7$ and Y_2BaCuO_5). This latter sample results from processing errors when attempting to make signal phase YBa_2CuO_7. The core-level XPS spectra for these samples were acquired in this investigation.

42492 (AD-A–206685/0/XAB) **Superconducting oxide films for multispectral infrared sensors. Final report, 1 January-31 December 1988.** Braginski, A.I.; Forrester, M.G. Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center. 7 Feb 1989. 43p. Available from NTIS, PC A03/MF A01.

The authors investigated optical detection in epitaxial and granular films of $YBa_2Cu_3O_7$-Delta, at wavelengths of 0.63, 3.39, and 10.6 micrometers, at temperatures from 4.2K to 100K. Epitaxial films, and granular films fabricated at Westinghouse, exhibit an optically-induced voltage shift, Delta V, which is proportional to the temperature derivative of the sample dc resistance at the same bias current. Granular films provided by the University of Texas, which exhibit 'semiconducting' resistive behavior, exhibit a response which deviates from dR/dT, but which can be explained in terms of the temperature dependence of the film thermal conductance. The response time of all films is long and strongly wavelength dependent, varying from of order microseconds at 0.63 micrometers to tenths of a second at 3.39 micrometers. Results indicate that all these films exhibit only bolometric or thermal detection, with no evidence for quantum or non-equilibrium effects in this temperature range.

42493 (AD-A–206849/2/XAB) **Crack-growth resistance in transformation-toughened ceramics.** Stump, D.M.; Budiansky, B. Harvard Univ., Cambridge, MA (USA). Div. of Applied Sciences. Jun 1989. 22p. (MECH–124). Available from NTIS, PC A03/MF A01.

Crack-growth resistance in transformation-toughened ceramics is studied by modeling the region surrounding an advancing crack tip as a zone that has undergone a uniform dilatational phase transformation. This zone is allowed to evolve around advancing crack tip under conditions of increasing far-field load while the tip is maintained at a critical stress intensity necessary for fracture. This procedure leads to the surprising conclusion that maximum toughening occurs for finite amounts of crack advance. The discovery of enhanced fracture-toughness zirconia-enriched ceramics has led to a flurry of experimental and theoretical analyses. It was well established that the high stresses near a crack tip can cause small zirconia particles, typically one micron or less in diameter, to undergo a phase transformation from a tetragonal to a monoclinic crystal structure.

42494 (AD-A–206970/6/XAB) **Tunable high-T, superconducting infrared detectors. Phase 1. Final report, August 1988-February 1989.** Klein, J.D. EIC Labs., Inc., Norwood, MA (USA). Feb 1989. 27p. (C–981F). Available from NTIS, PC A03/MF A01.

This program is aimed at the development of superconductor-based infrared detector in which sensitivity is optimized through control over composition and microstructure. Cation composition and thin film morphology are to be determined precisely in the thin film deposition process. The superconducting thin film is to have an oriented polycrystalline microstructure to achieve Josephson junction behavior directly through the anisotropic superconducting properties of YBa2Cu3O7-x. The deposition substrate will be an oxygen ion conductor to permit continuous and controlled adjustment of the superconductor's oxygen stoichiometry. Since the properties of the new oxide superconductors are so dependent on the oxygen stoichiometry of the crystal lattice, such a device can be tuned for various operating conditions. Keywords: Superconductors, Infrared detectors, YBa2Cu3O7, Ion conductors, Thin film. (jes)

42495 (AD-A–207064/7/XAB) **Properties of yttria-tetragonal zirconia polycrystal (Y-TZP) materials after long-term exposure to elevated temperatures. Final report.** Swab, J.J. Army Materials Research Agency, Watertown, MA (USA). Materials Technology Lab. Mar 1989. 28p. (MTL-TR–89-21). Available from NTIS, PC A03/MF A01.

Due to an unusual combination of high strength and toughness, tetragonal zirconia polycrystal (TZP) materials are candidates for use in advanced heat engines. The properties of these materials

stem from the stress-assisted transformation of metastable tetragonal zirconia particles. However, after long times at elevated temperatures, this class of materials is susceptible to properties degradation due to the undesirable transformation of tetragonal zirconia to monoclinic zirconia upon cooling. Accordingly, a task was initiated to examine the extent and magnitude of this phenomenon's effect on the properties. Seven commercially available yttria-tetragonal polycrystal (Y-TZP) materials were evaluated. Room-temperature properties were measured before and after heat treatments at 1000 C. Microstructure and phase stability were also examined. In all but one case, the Y-TZPs showed very little change in room temperature properties after long times at this temperature.

42496 (AECL–9087) **Review of glass-ceramics for the immobilization of nuclear fuel recycle wastes.** Hayward, P.J. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 87p. Order Number DE89635024/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

This report reviews the status of the Canadian, German, U.S., Japanese, U.S.S.R. and Swedish programs for the development of glass-ceramic materials for immobilizing the high-level radioactive wastes arising from the recycling of used nuclear fuel. The progress made in these programs is described, with emphasis on the Canadian program for the development of sphene-based glass-ceramics. The general considerations of product performance and process feasibility for glass-ceramics as a category of waste form material are discussed. 137 refs.

42497 (AECL–9384) **Photon CT scanning of advanced ceramic materials.** Sawicka, B.D.; Ellingson, W.A. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Feb 1987. 16p. Order Number DE89635032/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Advanced ceramic materials are being developed for high temperature applications in advanced heat engines and high temperature heat recovery systems. Small size flaws (10 - 200 μm) and small nonuniformities in density distributions (0.1 -2%) present as long-range density gradients, are critical in most ceramics and their detection is of crucial importance. Computed tomographic (CT) imaging provides a means of obtaining a precise two-dimensional density map of a cross section through an object from which accurate information about small flaws and small density gradients can be obtained. With the use of high energy photon sources high contrast CT images can be obtained for both low and high density ceramics. In the present paper we illustrate the applicability of the photon CT technique to the examination of advanced ceramics. CT images of sintered alumina tiles are presented from which data on high-density inclusions, cracks and density gradients have been extracted.

42498 (AECL–9437) **High-resolution computed tomography for flaw detection in advanced thin-layer ceramics for fuel cells.** Sawicka, B.D.; Ellingson, W.A.; McPheeters, C. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Jun 1987. 20p. (CONF-870172–: 11. annual conference on composites and advanced ceramic materials, 18-23 Jan 1987). Order Number DE89635042/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Advanced monolithic solid oxide fuel cells are being assembled from thin (~50 μm) tape-cast ceramic layers with highly tailored mechanical properties. The layers need to be free of cracks and nonbonds. A high-resolution computed tomography system with a Ir-192 source was investigated as a tool for detecting cracks and nonbonds. Results suggest that channel sizes, including internal channels, can be determined but small in-plane cracks cannot be detected.

42499 (ANL/APS-TM–3, pp. 45-68) **In situ high pressure-temperature research related to earth and planetary interiors.** Manghnani, M.H.; Hemley, R.J.; Jephcoat, A.P.; Bassett, W.A.; Heinz, D.L. Argonne National Lab., IL (USA). Apr 1988. (CONF-880194–: Workshop on synchrotron X-ray sources and new opportunities in the earth sciences, 18-20 Jan 1988). In *Synchrotron x-ray sources and new opportunities in the earth sciences: Workshop report.* Order Number DE88009858/JAW. Available from NTIS, PC A07/MF A01.

High pressure-temperature research is vitally important for the study of the composition, thermal state and processes in the Earth and planetary interiors. Measurements of the physical and chemical properties of rocks and plausible mantle mineral phases under appropriate conditions of pressure and temperature, together with interrelationships of such data with the geophysical and geochemical observations, are indispensable for a better understanding and a basis for theoretical modeling of the planetary interiors. For solving problems related to the Earth and planetary interiors, we need to know the elastic, thermodynamic and rheological properties, as well as crystal structure and phase equilibria, of candidate assemblages in the system Mg-Fe-Al-Ca-Na-Si-O-H. Progress in these areas depends not only on the precise measurements of the physical and chemical properties of candidate minerals and extending the pressure-temperature (P-T) ranges of experimental facilities to match the conditions of the Earth's deep interior, but also the ability to carry out the measurements under in situ pressure-temperature conditions.

42500 (CEA-CONF–9779) **Irradiation experiments in superconductors.** Quere, Y. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie. 1988. 7p. (CONF-881206–: 4. Israel materials engineering conference, Beer-Sheva (Israel), 7-8 Dec 1988). Order Number DE89903282/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Some experiments are described in which irradiation may provide a better understanding of properties of superconducting materials. Irradiation is used as a well controlled continuous source of dopants of various kinds (point defects, clusters...). Effects of radiation on critical temperature and resistivity are reviewed.

42501 (CONF-890701–2) **Static and time dependent magnetization studies of $Y_1Ba_2Cu_3O_z$ thin films.** Sekula, S.T.; Feenstra, R.; Thompson, J.R.; Kim, Y.C.; Christen, D.K.; Kerchner, H.R.; Deeds, H.A.; Boatner, L.A. Oak Ridge National Lab., TN (USA). Jul 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From International cryogenic materials conference; 24-28 Jul 1989. Order Number DE89016079/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Thin films of $Y_1Ba_2Cu_3O_z$ (YBCO) were deposited by electron-beam coevaporation of Y, Cu, and BaF_2 onto single-crystal substrates of $SrTiO_3$ and $KTaO_3$. Various oxygen annealing protocols produced different epitaxial alignments of the films, which were then studied using vibrating sample (VSM) and SQUID-based magnetometry. The magnetization behavior and the critical current density $J_c(H,T)$ deduced from the magnetic hysteresis is observed to be quite sensitive to the substrate orientation as well as to annealing procedures that result in variations of the film morphology as evidenced by x-ray diffraction and SEM techniques. Flux creep effects are also observed over short time intervals in VSM studies an examined quantitatively over longer periods with SQUID magnetometer. 13 refs., 6 figs.

42502 (CONF-890718–14) **Comparison between $LaGaO_3$, $LaAlO_3$, $KTaO_3$, and $SrTiO_3$ substrates for the epitaxial growth of $YBa_2Cu_3O_{7-x}$ thin films by a "BaF_2 process".** Feenstra, R.; Budai, J.D.; Galloway, M.D.; Boatner, L.A. Oak Ridge National Lab., TN (USA). 1989. 2p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From International conference on materials and mechanisms of superconductivity - high-temperature superconductors; Stanford, CA (USA); 23-28 Jul 1989. Order Number DE89015872/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

$YBa_2Cu_3O_{7-x}$ films with thicknesses in the range 60–320 nm were grown on $LaGaO_3$, $LaAlO_3$, $KTaO_3$, and $SrTiO_3$ single-crystal substrates by coevaporation of Y, Cu, and BaF_2 followed by annealing at 850°C in wet oxygen. Films formed with a thickness of 160 nm or greater on $SrTiO_3$, $KTaO_3$, and $LaGaO_3$ exhibited sharp superconducting transitions near T_c = 91 K. For films on $LaAlO_3$, T_c was typically reduced by 6–8 K. For films with a thickness less than 120 nm, the superconducting transition broadens for every film-substrate combination investigated, and T_c shifts to lower temperatures with decreasing film thickness. 6 refs., 1 fig.

42503 (CONF-8906155–4) **Time resolved reflectivity measurements in Pb-implanted $SrTiO_3$.** McCallum, J.C.; Rankin, J.; White, C.W.; Boatner, L.A. Oak Ridge National Lab., TN (USA). Jun 1989. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Radiation effects in insulators-5: crystalline oxides and ceramics session; 19-23 Jun 1989. Order Number DE89016234/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Time resolved optical reflectivity (TRR) is a simple and elegant technique for dynamically monitoring the interface motion that occurs during crystallization of thin films and amorphous layers on crystalline substrates. This in situ technique has enabled measurements of the solid-phase epitaxial regrowth rate of amorphous silicon layers produced by ion implantation to be extended by over five orders of magnitude to rates in excess of 10^6 Å/s. TRR is also well suited to measurements of crystallization kinetics in ion-implanted ceramic oxides. In the present work, the technique is used to directly monitor the regrowth during thermal annealing of amorphous layers produced by ion implantation in the crystalline ceramic oxide $SrTiO_3$. In particular, the effect of ambient water vapour on the epitaxial regrowth rate of amorphous layers in these materials has been examined. This study provides new insight into the role of water in regrowth of materials of this nature and clearly illustrates the utility of TRR in measurements of crystallization rates in ceramic oxides. 11 refs., 5 figs.

42504 (CRIEPI-EW–87002) **A study on the thermal shock resistance of ceramics - the thermal shock tests of ceramics in the high temperature and high speed combustion gas flow.** Hisamatsu, T.; Abe, T.; Hamamatsu, T.; Kosugi, T.; Iijima, S.; Miyata, H.; Ooshima, R. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Jul 1987. 52p.

The thermal shock resistance of ceramics was tested in the high temperature and high speed combustion gas flow (about 1500 degrees C, Mach number 1) to evaluate the reliability of ceramic stator blades. It is shown that the relationship between the thermal stress and the fracture of ceramics can be analyzed quantitatively because the fracture process and the temperature distribution of ceramics can be measured in this test. Therefore, the thermal shock test of ceramics at high temperature over 1000 degrees C is made possible by this method.

42505 (IAE–4575-11) **Diffusion-track model of gas release from grain boundaries in RAMP-type transients.** Lemekhov, S.E. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1988. 32p. (In Russian). Order Number DE89635060/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The model is proposed that can be used for analysis of the kinetics of gas release from uranium dioxide in the RAMP-type transients taking into account the determining influence of the basic structural and radiation factors such as concentration and sizes of intergrain pores, distribution and density of extended defects in the matrix: irradiation temperature; burnup etc. The model is based on quantitative realization of mechanisms of gaseous fission product diffusion and self-diffusion of uranium ions which may be supposed to be in the zone of fission product track at the initial stages of its formation and annealing. 37 refs.; 4 figs.; 3 tabs.

42506 (INIS-SU–103/A, pp. 20-21) **Quasistatic nondissipative motion of a solitary domain wall in ferrite garnet films.** Grigorenko, A.N. (AN SSSR, Moscow (USSR). Inst. Obshchej Fiziki); Mishin, S.A.; Rudashevskij, E.G. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Quantum radiophysics. Collection.* Order Number DE89012203/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 12.

Evidence of suppression of quasistatic dissipative losses in ferromagnetics by external nonuniform magnetic field in a wide range of this field gradient values from 10^4 to $2.3x10^5$ E/cm with the accuracy of detection of 10μm solitary domain wall motion up to 10A is experimentally stated. $(LuBi)_3(FeGa)_5O_{12}$ thin ferrite-garnet films, period of equilibrium domain structure of 50 μm are studied. The fact of suppression of quasistatic dissipative losses may be used for controlling coercivity of ferromagnetics. 8 refs.; 1 fig.

42507 (INIS-SU–109/A, pp. 26-28) **Composition effect on magnetic properties and specific heat of high temperature superconducting ceramics $RBa_2Cu_3O_{6.5+\delta}$.** Anshukova, N.V.; Bugoslavskij, Yu.V.; Veselago, V.G. and others. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics.* Order Number DE89012198/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 10.

A study was made on magnetization and specific heat near T_c of superconductivity high-temperature (HTSC) ceramics $RBa_2Cu_3O_{6.5+\delta}$ at R=Y, Gd, Ho and oxygen content in δ range from 0.1 up to 0.5. It is shown that change of oxygen content affects the critical temperature and the character of superconducting transition. 6 refs.; 2 figs.

42508 (INIS-SU–109/A, pp. 38-39) **Ion sputtered films of Y-Ba-Cu-O.** Bagulya, A.V.; Kazakov, I.P.; Maksimovskij, S.N.; Negodaev, M.A.; Shotov, A.P. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics.* Order Number DE89012198/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 10.

The structure and electric properties of Y-Ba-Cu-O films, grown during ceramic target sputtering by ion beam were investigated. Polycrystalline films with nitrogen temperatures of transition to completely superconducting state were obtained. 7 refs.; 2 figs.

42509 (LA-UR–89-2346) **Overview of irradiation effects research on insulating ceramics.** Clinard, F.W. Jr. Los Alamos National Lab., NM (USA). 1988. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8809163–2: Agreement on the program on joint planning in the area of fusion materials topical meeting, 2-6 Sep 1988). Order Number DE89015264/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Insulating ceramics have many uses in fusion reactors. Although various environmental conditions can degrade these materials, the most severe problems lie in the area of irradiation damage. Such damage can be detrimental to dimensional stability, strength, thermal conductivity, and various electrical properties; failure of an insulator can result from deleterious changes in any of these areas. Degradation of electrical properties falls into two categories: permanent effects, and transient effects that occur only when irradiation fluxes are actually impinging on the material. Consequences of irradiation damage can be severe not only for power reactors but for nearer-term machines such as ITER. Fusion reactors will require electrical ceramics to serve as insulators in rf heating systems and neutral beam injectors, diagnostic components, lightly-shielded magnetic coils, and current breaks between metallic structural elements. When these insulators are subjected to radiation fields (neutron, gamma, or ion bombardment) various physical properties can be degraded; these are discussed.

42510 (LBL–27403) **Evidence for unconventional superconductivity in UPt_3: Splitting of the specific heat anomaly at Tsub c.** Phillips, N.E.; Fisher, R.A.; Kim, S.; Woodfield, B.F.; Taillefer, L.; Hasselbach, K.; Flouquet, J.; Giorgi, A.L.; Smith, J.L. Lawrence Berkeley Lab., CA (USA). 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098;W-7405-ENG-36. (CONF-890718–13: International conference on materials and mechanisms of superconductivity - high-temperature superconductors, Stanford, CA (USA), 23-28 Jul 1989). Order Number DE89015232/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The specific heats of two samples of UPt_3 have been measured in the vicinity of T_c. Both samples show specific heat anomalies sharper than any previously observed and two clearly resolved maxima. The results are interpreted as evidence of splitting of the transition and unconventional pairing. 9 refs., 1 fig., 1 tab.

42511 (LBL–27404) **Specific heat of the high-T_c $YBa_2(Cu_{3-x}M_x)O_7$ with M = Cr or Zn.** Kim, S.; Fisher, R.A.; Phillips, N.E.; Gordon, J.E. Lawrence Berkeley Lab., CA (USA). Jun 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890718–12: International conference on materials and mechanisms of superconductivity -

high-temperature superconductors, Stanford, CA (USA), 23-28 Jul 1989). Order Number DE89015233/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The effects of substitution of Cr and Zn for Cu in YBCO have been studied calorimetrically and by magnetic measurements. There is a qualitative correlation between the suppression of the superconducting transition and an increase in the concentration of localized moments in both cases. 4 refs., 4 figs., 1 tab.

42512 (LBL–27405) **Lattice and electronic specific heat of $YBa_2Cu_3O_7$.** Gordon, J.E.; Fisher, R.A.; Kim, S.; Phillips, N.E. Lawrence Berkeley Lab., CA (USA). Jun 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890718–15: International conference on materials and mechanisms of superconductivity - high-temperature superconductors, 23-28 Jul 1989). Order Number DE89015235/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We report specific heat measurements on $YBa_2Cu_3O_7$ (YBCO) from 78 to 284K. The higher temperature data are well- represented as the sum of a term proportional to T and a harmonic lattice contribution. These data show no evidence of an anomaly in the temperature region 200–230K. The data near T_c are consistent with the specific heat of a BCS superconductor that has a contribution from 3-dimensional Gaussian fluctuations. 3 refs., 3 figs.

42513 (PB–89-188569/XAB) **Advanced ceramics: a critical assessment of wear and lubrication. Topical report, June-October 1986.** Munro, R.G.; Hsu, S.M. National Inst. of Standards and Technology (IMSE), Gaithersburg, MD (USA). Ceramics Div. Jan 1989. 109p. (NISTIR–88/3722). Available from NTIS, PC A06/MF A01.

See also PB–88-215447.

A critical assessment of the state of the art of the tribology of ceramics is made. To identify the critical technical barriers confronting the utilization of advanced gas-fired engines, data were gathered specifically on the tribology of materials for gas-fired engine applications. Site visits and discussions with a number of GRI contractors in industry were conducted as the first step in identifying critical issues. Then, an extensive review of the technical literature was made to determine what information was available to resolve those issues, and, more importantly, what critical information was not yet available. These data were used to examine the issues for each of the principal engine types (rotary, reciprocating, and turbine). Materials-property data for ceramics were then reviewed in the context of the operating environments and conditions for these engines. Thermal, mechanical, and tribological properties were examined, along with the important considerations for lubricating ceramics in engine applications. The analysis of these data considered the impact and relative merits of using various advanced materials and resulted in recommendations for research activities that could have a significant impact on the development of gas-fired prime movers.

42514 (PB–89-862320/XAB) **Silicon nitrides. January 1970-May 1989 (Citations from the US Patent data base). Report for January 1970-May 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 95p. Available from NTISPC N01/MF N01.

Supersedes PB–88-857297.

This bibliography contains citations of selected patents concerning silicon nitride (SN) materials and their applications in industries, including the uses of SN films in semiconductor devices, cutting tools, and gas turbine components. Methods of producing protective, thermally stable, and electrically insulating SN materials by sintering and densification are discussed. Nitridation, and deposition processes of producing SN films on semiconductor substrates are disclosed. (This updated bibliography contains 216 citations, 34 of which are new entries to the previous edition.)

42515 (SAND–89-0918C) **Shock compression and release in high-strength ceramics.** Kipp, M.E.; Grady, D.E. Sandia National Labs., Albuquerque, NM (USA). [1989]. 5p. Sponsored by DOD;DOE/DP. DOE Contract AC04-76DP00789. (CONF-890812–6: American Physical Society topical conference on shock compression of condensed matter, Albuquerque, NM (USA), 14-17 Aug 1989). Order Number DE89016418/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Shock compression and release particle velocity data have been obtained for silicon carbide, titanium diboride, boron carbide, and zirconium dioxide with a laser velocity interferometer (VISAR). Peak impact stresses in these experiments range between 20 and 50 GPa. Iterative numerical methods were used to obtain dynamic compression and release stress-strain behavior of the ceramics. 16 refs., 4 figs., 3 tabs.

42516 (SAND–89-1461) **Shock compression and release in high-strength ceramics.** Kipp, M.E.; Grady, D.E. Sandia National Labs., Albuquerque, NM (USA). Aug 1989. 54p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89013995/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

A preliminary investigation of shock compression and release properties has been performed on four ceramics: silicon carbide, titanium diboride, boron carbide and zirconium dioxide. Eight planar impact experiments using thin discs of similar ceramic as impactor and target have been completed. The particle velocity history at the interface between the back of the target ceramic and a lithium fluoride window material was acquired with a laser velocity interferometer (VISAR). These wave profiles indicate that each of these materials responds in a unique way to shock loading. Peak impact stresses in these experiments range between 20 and 50 GPa, leading to pronounced permanent deformation behavior of these materials. Dynamic compression and release stress-strain behavior of the ceramics, formulated with numerical iteration methods, is compared with compressive strength properties determined from the experimental data. The current experiments provide data for these ceramic materials which can be used to evaluate computational material models in wave propagation codes. 23 refs., 25 figs., 4 tabs.

42517 (SAND–89-1876C) **Structural aspects of the phase separation in $La_2CuO_{4.032}$.** Chaillout, C.; Chenavas, J.; Cheong, S.W.; Fisk, Z.; Lehmann, M.S.; Marezio, M.; Morosin, B.; Schirber, J.E. Sandia National Labs., Albuquerque, NM (USA). 1989. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890718–24: International conference on materials and mechanisms of superconductivity - high-temperature superconductors, 23-28 Jul 1989). Order Number DE89016183/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The average structure of superconducting $La_2CuO_{4.032}$ has been determined by single-crystal neutron diffraction data. The excess oxygen is located between two adjacent LaO layers. Its presence distorts the apical-oxygen sublattice in such a way that a short O–O bond is formed (1.64Å). By scanning several hkl reflections, we have confirmed that a phase separation occurs below room temperature. The peaks of one phase are in agreement with the space group Cmca and the unit cell proposed by Jorgensen et al., and Cox et al., however, a monoclinic unit cell is needed to index the second phase reflections. 3 refs., 2 figs.

42518 (UCRL–101356) **Comparison of the electronic structure of La_2CuO_4, La_2NiO_4, and K_2CuF_4.** Grant, J.B.; McMahan, A.K. Lawrence Livermore National Lab., CA (USA). Jun 1989. 2p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890718–18: International conference on materials and mechanisms of superconductivity - high-temperature superconductors, Stanford, CA (USA), 23-28 Jul 1989). Order Number DE89016644/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We report local density calculations of parameters defining extended Hubbard Hamiltonians for La_2CuO_4, La_2NiO_4, and K_2CuF_4, and solve these models for small clusters. These results suggest qualitative differences among the three compounds in regard to spin system, carriers, and carrier — spin interactions. 6 refs., 2 tabs.

42519 (UCRL–101357) **Magnetic pair breaking in $Y_{1-x}Pr_xBa_2Cu_3O_7$.** Radousky, H.B.; Hahn,P.A.; Peng, J.L.; Shelton, R.N. Lawrence Livermore National Lab., CA (USA). Jun 1989. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890718–19: International conference on materials and mechanisms of superconductivity - high-temperature

superconductors, Stanford, CA (USA), 23-28 Jul 1989). Order Number DE89016643/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The upper critical fields, H_{c2}, for $Y_{1-x}Pr_xBa_2Cu_3O_7$ are observed to be "bell" shaped for $x \geq 0.3$. This provides strong evidence for the importance of magnetic interactions in this system. 7 refs., 3 figs.

42520 Defect properties and processing of high-technology nonmetallic materials. Materials Research Society symposia proceedings. Volume 60. Chen, Y.; Kingery, W.D.; Stokes, R.J. 531p. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217– : Materials Research Society meeting, 2-7 Dec 1985).

These proceedings collect papers on defects in ceramic materials. Topics include: aqueous dispersions of ZrO_2 and Al_2O_3, Co_2-laser processing of ultra-high-purity Al_2O_3, isostatically pressed niobium carbide, dislocations in non-metallic crystalline materials, alkali borate classes, ion beam, rapid thermal, and laser mixing phenomena; ion implantation of crystalline oxides; optical properties of YAGs, mechanical properties of ZrO_2-containing ceramics, and yttria-stabilized zirconia polycrystals.

42521 Better ceramics through chemistry III; Proceedings of the Symposium, Reno, NV, Apr. 5-9, 1988. MRS Symposia Proceedings. Volume 121. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. 868p. Materials Research Society, Pittsburgh, PA (1988). (CONF-8804114–: Better ceramics through chemistry III, 5-9 Apr 1988).

The present conference on sol-gel chemical methods for ceramic production discusses topics in the sol-gel methodology of silicates and nonsilicates, structure-property relationships in sol-gel products, powder synthesis and processing methods, sol-gel composition characterization methods, polymeric-precursor nonoxide ceramics production, aerogels, and sol-gel film-production methods. Attention is given to branching theory in sol-gel processing, polymetallic alkoxide precursors for ceramics, syneresis in silica gel, nanometer-sized inorganic gel particles, sol-gel protective films for metallic solar mirrors, the 'Varogel' glass-formation technique, the optimization of sol-gel film properties, luminescent oxide gels, and the sol-gel processing of transparent $MgAl_2O_4$.

42522 Clean-room and CO_2-laser processing of ultra high-purity Al_2O_3. Morris, P.A. (Massachusetts Institute of Technology, Cambridge, MA (US)); Coble, R.L.; French, R.H.; Tebbe, F.N.; Chowdhry, U. vp. of Defect properties and processing of high-technology nonmetallic materials. Chen, Y.; Kingery, W.D.; Stokes, R.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

Clean-room powder processing, furnace firing, and CO_2-laser heating techniques to produce high-purity Al_2O_3 ceramics were applied to a new source of high-purity Al_2O_3 (<13 ppm total and <8 ppm cation detected impurities). The chemical analyses of the material after each stage of processing and firing indicate that the procedures used in this work give no detectable contamination of the material. The microstructure of a CO_2-laser ultra high-purity Al_2O_3 is illustrated. Densification is incomplete for this material. Calcination and deagglomeration were not optimized. Procedures, such as these are required to control the trace impurity contents in a fired ceramic material.

42523 Kinetics and mechanisms of creep in hot isostatically pressed niobium carbide. Nixon, R.D. (Oak Ridge National Labs., Oak Ridge, TN (US)); Davis, R.F.; Bentley, J. vp. of Defect properties and processing of high-technology nonmetallic materials. Chen, Y.; Kingery, W.D.; Stokes, R.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

Constant compressive stress creep experiments in the temperature and stress ranges of 1730K - 2100K and 16 MN/m^2 - 70 MN/m^2 on HIPed $NbC_{0.74}$ have revealed stress exponents of 2.0 under stress levels of 16-54 MN/m^2 at all temperatures investigated and 3.2 under stress levels of 54-70 MN/m^2 at 1830K. The activation energy of steady state creep is approximately 230 kJ/mol in the temperature range of 1730K - 1930K under 48-54 MN/m^2 and 470 kJ/mol in the temperature range of 1900K - 2100K under 64 MN/m^2. TEM of the annealed but uncrept material reveals grown-in dislocation subboundaries. At 1730K and under 34-54 MN/m^2, these subboundaries become single dislocations and dipoles. At 1830K and under 54-70 MN/m^2 the subboundaries evolve into simple tilt boundaries which are occasionally knitted, indicating more glide activity at higher stresses. At 1930K and under 34-54 MN/m^2, hexagonal subboundaries form, but are not as well defined as in the annealed material. At 2100K and under 16-30 MN/m^2, the subboundaries are well-defined hexagonal networks which become polygonized under higher stresses on 64 MN/m^2. The experimental and TEM results indicate that at low temperatures (below 0.5 T_m = 2073K) and at all stresses, creep occurs by dislocation glide which is accompanied by subgrain and high angle boundary interaction. At high temperature (above 0.5 T_m), strain occurs by glide and subboundary movement; recovery occurs by climb in the subboundary.

42524 Structure of dislocations and interfaces in nonmetallic crystalline materials. Carter, C.B. (Cornell Univ., Ithaca, NY (US)). vp. of Defect properties and processing of high-technology nonmetallic materials. Chen, Y.; Kingery, W.D.; Stokes, R.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

The present understanding of the structure of grain boundaries and phase boundaries in ceramic materials is briefly reviewed with a view to extracting general conclusions on the structure of such interfaces. Examples of experimental studies of grain boundaries in alpha-alumina, spinel and germanium are discussed together with illustrations of the wustite/spinel and sesquioxide/spinel interface. In the oxide systems discussed here, both the grain boundaries and phase boundaries can facet even in the case where the anion sublattice is effectively undisturbed, this observation emphasises the influence of the cations on the selection of the boundary plane.

42525 Formation and passivation of new paramagnetic defects associated with thermal oxides on silicon. Brower, K.L. (Sandia National Labs., Albuquerque, NM (US)). vp. of SiO_2 and its interfaces. Pantelides, S.T.; Lucovsky, G. Materials Research Society, Pittsburgh, PA (1988). (CONF-8711228–: SiO_2 and its interfaces symposium, 30 Nov - 5 dec 1987).

A new spin resonance spectrum has been observed with electron paramagnetic resonance in thermal oxides grown on (111) silicon. The analysis indicates that this new spectrum consists of two isotropic resonances. One resonance has a g-value of 2.0026 and a linewidth (FWHM) of 1.2 G (labeled SL8);l the other resonance has a g-value of 2.0029 and a linewidth (FWHM) of 5 G (labeled SL9). These spectra might be due to impurity contamination resulting from the oxidation process and associated defects at interior surfaces. The SL8 resonance in particular appears to be located within the as-grown thermal oxide. The effects of ^{60}Co gamma irradiation and annealing in either hydrogen or ammonia on these spectra are also presented in this paper.

42526 Structure of sol-gel silica. Brinker, C.J. (Sandia National Labs., Albuquerque, NM (US)); Brow, R.K.; Tallant, D.R.; Kirkpatrick, R.J. vp. of SiO_2 and its interfaces. Pantelides, S.T.; Lucovsky, G. Materials Research Society, Pittsburgh, PA (1988). (CONF-8711228–: SiO_2 and its interfaces symposium, 30 Nov - 5 dec 1987).

Combined Raman, ^{29}Si NMR and reactivity studies of silica gels indicate that dehydroxylation of the silica surface results in cyclotrisiloxane species with reduced Si-O-Si bond angles and altered acid/base characteristics. XPS experiments indicate that the expected 0.35 eV shifts in Si2p and O1s binding energies due to the reduced bond angles are hidden within broad peaks are also the remaining hydroxyls. Additional Si2P, O1S, and CIS peaks are also observed and are postulated to result from preferential adsorption of extrinsic C-containing species on sites with enhanced acid/base properties.

42527 Characterization of long period polytypoid structures in the Al_2O_3 - AlN system. Krishnan, K.M. (Lawrence Berkeley Lab., Berkeley, CA (US)); Rai, R.S.; Thomas, G.; Corbin, N.D.; McCauley, J.W. vp. of Defect properties and processing of high-technology nonmetallic materials. Chen, Y.; Kingery, W.D.; Stokes, R.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

Long period polytypoid structures observed along the pseudobinary Al_2O_3[AlN composition join at a composition of 95 mol% AlN have been investigated by convergent beam electron diffraction and

lattice imaging. Two new long period structures, 32H (Ramsdell notation) and 16H with c-periodicities of 8.3 nm and 4.07 nm respectively, have been independently identified by these two techniques. However, the 32H polytypoid was sometimes found to be intergrown with faulted 27R long period structure of periodicity 7.2 nm. Further, it has been shown that the 32H polytypoid is stabilized by local compositional fluctuations during the sintering process.

42528 The structure of surface steps on low-index planes of oxides. Susnitzky, D.W. (Cornell Univ., Ithaca, NY (US)); Simpson, Y.K.; DeCooman, B.C.; Carter, C.B. vp. of Defect properties and processing of high-technology nonmetallic materials. Chen, Y.; Kingery, W.D.; Stokes, R.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

Surface steps have been observed on low-index planes of alpha-alumina and spinel. The steps were produced by annealing both bulk and perforated thin foil single crystals. A comparative study of bright-field TEM and dark-field REM of the same crystals makes it possible to construct models for the surface structure. Many faceted steps can be observed on the (0001), {0112}, {1010} and {1120} surfaces of alpha-alumina and on the {100} surface of spinel. A detailed study of step faceting and step facet movement during reheating is presented.

42529 Atomic resolution studies of tilt grain boundaries in NiO. Merkle, K.L. (Argonne National Lab., Argonne, IL (US)); Reddy, J.F.; Wiley, C.L.; Smith, D.J.; Wood, G.J. vp. of Defect properties and processing of high-technology nonmetallic materials. Chen, Y.; Kingery, W.D.; Stokes, R.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

The atomic structures of a number of <001> high-angle tilt grain boundaries in NiO have been studied by high-resolution electron microscopy (HREM). Crystallinity is always maintained right up to the grain boundary (GB). Grain boundary planes bounded by a (100)-plane are preferred, however symmetrical facets are also found at each misorientation. A tendency to match atomic planes across the GB is not only observed in symmetrical, but also in asymmetrical GBs. Structural units can be clearly recognized in symmetrical GBs. Contrast differences suggest that a multiplicity of structural units exists for some GB configurations. Frequently symmetric GBs also show deviations from mirror symmetry. Multislice simulations indicate that the image contrast associated with HREM GB images is not particularly sensitive to GB relaxation.

42530 Electrical conductivity and seebeck coefficient of divalent-metal-doped $YCrO_3$. Weber, W.J. (Battelle Pacific Northwest Labs., Richland, WA (US)); Bates, J.L.; Griffin, C.W.; Olsen, L.C. vp. of Defect properties and processing of high-technology nonmetallic materials. Chen, Y.; Kingery, W.D.; Stokes, R.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

The substitution of divalent metal ions for Y(+3) in $YCrO_3$ results in a charge compensating transition of Cr(+3) to Cr(+4) and the formation of small polarons as charge carriers. The experimentally measured electrical conductivity, σ, and Seebeck coefficient, S, exhibit behavior consistent with a theoretical model developed for small polaron transport in these narrow-band semiconductors. The small polaron transport is a thermally-activated process with a measured activation energy, E, of about 0.18 to 0.25 eV in these materials. Both σ and S increase with temperature and show a near linear dependence on dopant concentration and a strong dependence on dopant (ionic) size. Analysis of the results in terms of the model indicates that Ca is much more effective in polaron formation than any of the other dopants in $YCrO_3$; this is due to the similar ionic size of Ca(+2) and Y(+3) which minimizes the lattice distortion from substitution.

42531 Electrical properties and defect structures of CoQ and MnO at high defect content. Sykora, G.P. (Northwestern Univ., Evanston, IL (US)); Mason, T.O. vp. of Defect properties and processing of high-technology nonmetallic materials. Chen, Y.; Kingery, W.D.; Stokes, R.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

Defect studies at high defect content in transition metal monoxides allow for the conduction mechanisms to be established and the nature of defect interactions to be studied. Conductivity and thermopower results in p-type, highly defective MnO are reported and analyzed with a combination of point defects and clusters. A high pressure oxygen apparatus to achieve defect contents up to 5 percent in CoO has been designed and constructed.

42532 Structure-transport relationships in fast ion conducting alkali borate glasses. Fusco, F.A. (Massachusetts Institute of Technology, Cambridge, MA (US)); Tuller, H.L.; Uhlmann, D.R. vp. of Defect properties and processing of high-technology nonmetallic materials. Chen, Y.; Kingery, W.D.; Stokes, R.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

The effect of CaO substitutions (between 1 and 10% $(CaO)_2$/Li_2O) on the transport and physical properties of two fast ion conducting lithium borate glass systems (37.3 mol % Li_2O, 62.7 mol % B_2O_3 and 50 mol % Li_2O, 50 mol % B_2O_3) are investigated. Measurements of electrical conductivity, density and glass transition temperature are reported. The influence of strain effects on carrier mobility is examined. Measurements of electrical conductivity and molar volume are extended to a K_2O x $2B_2O_3$ glass and compared with existing data for corresponding lithium and sodium diborate glasses.

42533 Electronic barriers produced at ZnO surfaces by ion implantation and annealing. Sonder, E. (Oak Ridge National Lab., Oak Ridge, TN (US)); Zuhr, R.A.; Martinelli, J.R. vp. of Defect properties and processing of high-technology nonmetallic materials. Chen, Y.; Kingery, W.D.; Stokes, R.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

Modern varistors are made of polycrystalline ZnO, doped to create Schottky-like barriers at the grain boundaries. To allow the study of tailored single barrier junctions, we have implanted ZnO crystals with Bi, Sb and transition metals. The electrical properties and the distribution of Bi and Sb were measured in the implanted crystals as a function of annealing temperature. After implantation and before heating, no barriers can be observed. After heating to 600-800^{0}C, a high voltage (insulating) barrier is created. Heating to above 1000^{0}C produces a 2-1/2 Volt barrier with high nonlinearity. The temperatures at which these barriers appear correspond, respectively, to temperatures at which motion of Sb and Bi first can be observed by ion backscattering techniques, and at which these elements diffuse freely.

42534 Ion beam, rapid thermal, and laser mixing phenomena in insulators. Narayan, J. (Oak Ridge National Lab., Oak Ridge, TN (US)); Appleton, B.R. vp. of Defect properties and processing of high-technology nonmetallic materials. Chen, Y.; Kingery, W.D.; Stokes, R.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

The authors have studied mixing of metal overlayers (Ni, Cr, Ti, W, Ta, Zr, Cu) on insulators (SiC, Si_3N_4, Al_2O_3, SiO_2) after ion beam irradiation, rapid thermal annealing, and pulsed laser irradiation. The nature and amount of mixing varies from stoichiometric to continuous, to ballistic, to no mixing at all. For a given system, the amount of mixing was found to increase with increasing substrate temperature. The enhanced mixing with increasing substrate temperature is correlated with concomitant free energy associated with the reactions. Certain systems such as Cu on Al_2O_3 do not exhibit mixing, but rearrangement within a few atomic layers at the interface results in enhanced adhesion and no aggregation upon annealing at moderate temperatures.

42535 Ion implantation and annealing of crystalline oxides. White, C.W. (Oak Ridge National Lab., Oak Ridge, TN (US)); Sklad, P.S.; Boatner, L.A.; McWargue, C.J.; Sales, B.C.; Farlow, G.C.; Aziz, M.J. vp. of Defect properties and processing of high-technology nonmetallic materials. Chen, Y.; Kingery, W.D.; Stokes, R.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

The crystallization of amorphous surface layers produced by ion implantation of single-crystal α-Al_2O_3 and $CaTiO_3$ are discussed.

During annealing, amorphous Al_2O_3 converts first to the γ-phase. The crystallized γ then transforms to the α-phase by the motion of a well-defined planar interface. The temperature dependence of the velocity of the γ/α interface has been measured and is characterized by an activation energy of ~3.6 eV. In $CaTiO_3$, crystallization of the amorphous phase takes place by solid-phase epitaxy. The velocity of the amorphous/crystal interface is characterized by an activation energy of 1.3 eV.

42536 The formation and annealing of amorphous layers of Al_2O_3. Farlow, G.C. (Wright State Univ., Dayton, OH (US)); Sklad, P.S.; White, C.W.; McHargue, C.J.; Appleton, B.R. vp. of Defect properties and processing of high-technology nonmetallic materials. Chen, Y.; Kingery, W.D.; Stokes, R.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

The critical dose for formation of an amorphous layer of Al_2O_3 by ion irradiation at 77 K has been determined. It is found to lie between 2 and 3 x $10^{15}/cm^2$ if the sample is irradiated near the <0001> axis of the substrate and is found to lie in the neighborhood of 2 x $10^{16}/cm^2$ if the irradiation is near the <1210> axis. The amorphous layers are found to recrystallize epitaxially if annealed at 1190 degrees C and to form a metastable microstructure upon annealing at 800 degrees C.

42537 Ion induced alterations of $LiNbO_3$. Buchal, C. (Oak Ridge National Lab., Oak Ridge, TN (US)); Appleton, B.R.; Christie, W.H.; Ashley, P.R. vp. of Defect properties and processing of high-technology nonmetallic materials. Chen, Y.; Kingery, W.D.; Stokes, R.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

An attempt is made to fabricate positive-index waveguides by ion implantation of metal ions into crystals of $LiNbO_3$. The observed structural, chemical, and optical damage is summarized and possible solutions are discussed.

42538 R-curve behavior and the mechanical properties of transformation-toughened ZrO_2-containing ceramics. Steinbrech, R.W. (Case Western Reserve Univ., Cleveland, OH (US)); Heuer, A.H. vp. of Defect properties and processing of high-technology nonmetallic materials. Chen, Y.; Kingery, W.D.; Stokes, R.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

Current understanding of R-curve behaviour and the strength-toughness relationship of transformation-toughened ZrO_2-containing ceramics is reviewed. If the toughness increases with crack extension along an R-curve, a maximum in strength versus toughness is observed, which is related to the crack instability criterion for R-curves. An analytical expression from a well-known wake theory of crack tip shielding is used to compute R-curves and strength/toughness relations, which are compared with experiment.

42539 X-ray photoelectron spectroscopy of in-situ fractured reaction bonded silicon nitride. Donley, M.S. (Univ. of Washington, Seattle, WA (US)); Stoebe, T.G.; Thomas, M.T. vp. of Defect properties and processing of high-technology nonmetallic materials. Chen, Y.; Kingery, W.D.; Stokes, R.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

The grain boundary chemistry of reaction bonded silicon nitride (RBSN) and the effects of iron species and content on this chemistry are investigated using X-ray photoelectron spectroscopy (XPS). Data are reported for semiconductor grade RBSN, Fe-doped semiconductor grade RBSN, and metallurgical grade RBSN specimens. Results indicate that the grain boundaries have an elemental composition of Si, N, O, and C, with important chemical differences depending on the purity of the starting material. In the RBSN made from metallurgical grade silicon, the grain boundaries have a distinct oxide-like layer, with a subregion of Si_3N_4. No distinct oxide layer was observed in the RBSN made from semiconductor-grade silicon, where the O appears to be uniformly incorporated into the Si_3N_4.

42540 The hardness of ion implanted ceramics. Oliver, W.C. (Oak Ridge National Lab., Oak Ridge, TN (US)); McHargue, C.J.; White, C.W.; Farlow, G.C. vp. of Defect properties and processing of high-technology nonmetallic materials. Chen, Y.; Kingery, W.D.; Stokes, R.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

It has been established that the wear behavior of ceramic materials can be modified through ion implantation. Studies have been done to characterize the effect of implantation on the structure and composition of ceramic surfaces. To understand how these changes affect the wear properties of the ceramic, other mechanical properties must be measured. To accomplish this, a commercially available ultra low load hardness tester has been used to characterize Al_2O_3 with different implanted species and doses. The hardness of the base material is compared with the highly damaged crystalline state as well as the amorphous material.

42541 Point defects and high-temperature deformation of NiO. Goretta, K.C. (Argonne National Lab., Argonne, IL (US)); Routbort, J.L. vp. of Defect properties and processing of high-technology nonmetallic materials. Chen, Y.; Kingery, W.D.; Stokes, R.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

The steady-state flow stress tau_s in nonstoichiometric NiO single crystals has been measured in the temperature range of 1428 to 1653 K with oxygen partial pressures $rho(O_2)$ between 6 and $1x10^5$ Pa. Strain rates ϵ were varied from $1x10^{-5}$ to $2x10^{-3}$ s^{-1}. Transmission electron microscopy indicates that dislocation climb is the primary mechanism of recovery. Because dislocation climb is diffusion controlled, the data may be described at fixed temperature by $\epsilon = A tau^n_s rho(O_2)^1 m$, where n is the stress exponent and m is a parameter that is determined by the dominant atomic defects on each sublattice. At high temperatures and $rho(O_2) > 2x10^4$ Pa, n was found to be in agreement with dislocation-climb models; however, n increased at low $rho(O_2)$ owing to effects of impurities. The values of m are consistent with control of climb rate by diffusion of singly charged oxygen vacancies for low $rho(O_2)$ and by diffusion of neutral oxygen interstitials for high $rho(O_2)$. At lower temperatures, the values of n are strongly affected by dislocation/impurity interactions for all $rho(O_2)$.

42542 Grain-boundary migration in nonstoichiometric solid solutions of magnesium aluminate spinel. Chiang, Y.M. (9501197); Kingery, W.D. *Journal of the American Ceramic Society (USA)*, 72(2): 271-277 (Feb 1989).

The grain-boundary mobility in magnesium aluminate spinel of magnesia-rich and alumina-rich compositions has been measured from normal grain growth in dense, hot-pressed samples. Over the temperature range 1200^0 to 1800^0C, the mobility in magnesia-rich compositions is found to be greater than that in alumina-rich compositions by a factor of 10^2 to 10^3.

42543 Elevated-temperature fracture resistance of a sintered α-silicon carbide. Ghosh, A. (9519302); Kobayashi, A.S.; Jenkins, M.G.; White, K.W.; Bradt, R.C. *Journal of the American Ceramic Society (USA)*, 72(2): 242-247 (Feb 1989).

The fracture toughness of a dense, sintered commercial α-silicon carbide was determined for temperatures from 20^0 to 1400^0C using the straight- and chevron-notched test specimens and also controlled-surface-microflow specimens, all in three-point bending. The flexural strengths were also measured for the same range of temperatures and the trend is compared with that of the toughness. Measurements from this study are discussed and also compared with other results in the literature.

42544 Influence of temperature gradients on sintering. Beruto, D. (2739000); Botter, R.; Searcy, A.W. *Journal of the American Ceramic Society (USA)*, 72(2): 232-235 (Feb 1989).

The H_2O-catalyzed sintering of MgO in temperature gradients between 1303 and 1233 K is compared to sintering of isothermal samples. Both the changes in sample dimensions in planes normal to the temperature gradients and the increases in density for a fixed sintering time are greater than predicted on the assumption that densification in a temperature gradient is a function only of each local temperature in the gradient. Under the conditions used, neither vapor transport nor transport through a liquid phase is important. The results, support a recent prediction that temperature gradients supplement surface energy changes in driving sintering and related processes.

42545 Effects of aspect ratios of ellipsoidal inclusions on elastic stress transfer of ceramic composites. Hsueh, C.H. (9501970). *Journal of the American Ceramic Society (USA),* 72(2): 344-347 (Feb 1989).

The elastic stress transfer from a ceramic matrix to aligned ellipsoidal inclusions is analyzed for the case where the axis of the applied load is parallel to the axis of the ellipsoid. Perfect bonding between the matrix and inclusions is assumed. The calculation is based on Eshelby's model for loading of an infinite matrix containing an ellipsoidal inclusion, and the modification to account for the effect of finite volume fractions of inclusions. The results show that the transfer of the axial stress from the matrix to inclusions increases with the increase in the aspect ratio of the ellipsoid, and decreases with the increase in the volume fraction of inclusions when Young's modulus of the inclusion is higher than that of the matrix.

42546 Effects of temperature and whisker volume fraction on average residual thermal strains in a SiC/Al_2O_3 composite. Majumdar, S. (9507856); Kupperman, D. *Journal of the American Ceramic Society (USA),* 72(2): 312-313 (Feb 1989).

Residual thermal strains in a SiC-whisker-reinforced/Al_2O_3-matrix composite were measured as functions of temperature and volume fraction of whiskers by means of a neutron diffraction technique. The residual strains in both phases decrease with increasing temperature. At room temperature, the residual strains in the whiskers decrease with increasing whisker volume fraction, but the tensile residual strains in the matrix increase.

42547 Improved superconducting $Y_1Ba_2Cu_3O_{6.9}$ through high temperature processing. Ginley, D. S. (Sandia National Laboratories, P.O. Box 5800, Albuquerque, New Mexico 87185 (US)); Venturini, E. L.; Kwak, J. F.; Baughman, R. J.; Morosin, B. *Journal of Materials Research (USA),* 4(3): 496-500 (May 1989). DOE Contract AC04-76DP00789.

The YBaCuO system has produced superconductors with superconducting transition temperatures (T_c) over 90 K. Integral to the production of these materials are high temperature sintering and subsequent oxygen annealing processes. In this paper we present results directed toward optimizing these two process steps. We find that oxygen stabilizes the $YBa_2Cu_3O_{6.9}$ material against decomposition to temperatures near the melting point, allowing processing at higher temperatures, which produces significantly higher quality single phase material and somewhat improved grain-to-grain contacts.

42548 Freestanding thick films of $YBa_2Cu_3O_{6.9}$ by screen-printing techniques. Ginley, D. S. (Sandia National Laboratories, P.O. Box 5800, Albuquerque, New Mexico 87185 (US)); Mitchell, M. A.; Kwak, J. F.; Venturini, E. L.; Baughman, R. J.; Fu, W. *Journal of Materials Research (USA),* 4(3): 501-504 (May 1989). DOE Contract AC04-76DP00789.

Thick (20–300 μm) freestanding polycrystalline films of ceramic $YBa_2Cu_3O_{6.9}$ have been obtained by resintering $YBa_2Cu_3O_{6.9}$ powder in air after screen printing onto fused silica substrates. An interfacial reaction occurs between the powder and the silica substrate which efficiently detaches the resintered film upon cooling. The magnetization and transport properties of these films are comparable to those for high quality bulk ceramic samples.

42549 Partial substitution of ^{18}O in $YBa_2Cu_3O_7$: Investigations of inhomogeneities and their effect on T_c. Ham, W. K. (College of Chemistry, University of California, Berkeley, California 94720 (US)); Keller, S. W.; Michaels, J. N.; Stacy, A. M.; Krillov, D.; Hodul, D. T.; Fleming, R. H. *Journal of Materials Research (USA),* 4(3): 504-514 (May 1989).

The possibility of site-selective substitution of ^{18}O into $YBa_2Cu_3O_7$ was explored. Samples containing various quantities of ^{18}O were prepared by processing in $^{18}O_2$ both at 950°C and at 400°C. The samples were characterized by secondary ion mass spectroscopy (SIMS), temperature programmed desorption (TPD) and reduction (TPR), Raman spectroscopy, and magnetization measurements. Measurements of the shifts in the Raman active modes with ^{18}O substitution and of the ratios of ^{18}O to ^{16}O by TPD, TPR, and SIMS show that even for temperatures as low as 400 °C and times as short as 2 h, ^{18}O is not substituted exclusively into the chain site (O1) in $YBa_2Cu_3O_7$. In addition, there is not consistent variation in the shifts in T_c with the degree of substitution; therefore, the isotope effect for a sample with 100% ^{18}O cannot be predicted by a linear extrapolation of data obtained for samples with partial ^{18}O substitution. The mechanism of oxygen substitution, the difficulties of measuring the true magnitude of the oxygen isotope shift, and the meaning of the small isotope shift are discussed.

42550 Electron microscopy of a Gd–Ba–Cu– superconductor. Ramesh, R. (Department of Materials Science and Mineral Engineering and National Center for Electron Microscopy, Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720 (US)); Thomas, G.; *Journal of Materials Research (USA),* 4(3): 515-520 (May 1989). DOE Contract AC03-76SF00098.

An electron microscopy study has been carried out to characterize the microstructure of a sintered Gd–Ba–Cu–O superconductor alloy. The $GdBa_2Cu_3O_{7-x}$ phase in the oxygen annealed sample is orthorhombic while in the vacuum annealed sample it is tetragonal. It is shown that the details of the fine structure in the [001] zone axis convergent beam patterns can be used to distinguish between the orthorhombic form and the tetragonal form. In addition to this matrix phase, an amorphous phase is frequently observed at the triple grain junctions. Gd-rich inclusions have been observed inside the matrix phase.

42551 Effects of chemical doping and stoichiometric variation in high-T_c superconductors. Kao, Y.H. (5958000); Song, L.W.; Yao, Y.O. *International Journal of Modern Physics B (USA),* 3(4): 573-594 (Apr 1989).

Superconducting properties of various chemically-doped high-T_c materials are investigated. By using the results obtained with Cu- and Bi-deficient Y-Ba-Cu-O and Bu-Sr-Ca-Cu-O systems as basis, variations of the transition temperature T_c, critical current density J_c, room temperature resistivity rho, and oxygen content are compared for different dopant contents. In several cases, J_c and rho are found to be correlated as both quantities show an exponential dependence on the dopant concentration. Most dopants result in a monotonic decrease of T_c and J_c, except for Ag, F, and Cl. Substitution of Ag and Pb for Cu and Bi in Bi-Sr-Ca-Cu-O indicates a condition for compatibility between the impurity atom and the local structure in the host matrix. Results suggest that the predominant mechanism for high-T_c superconductivity is most likely associated with short-range-order structure in the material.

42552 Origin of enhanced growth of the 110 K superconducting phase by Pb doping in the Bi-Sr-Ca-Cu-O system. Shi, D. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439 (US)); Boley, M. S.; Chen, J. G.; Xu, M.; Vandervoort, K.; Liao, Y. X.; Zangvil, A.; Akujieze, J.; Segre, C. *Applied Physics Letters (USA),* 55(7): 699-701 (14 Aug 1989). DOE Contract W-31-109-ENG-38.

Kinetics of the 110 K superconducting phase formation has been studied in the Bi-Sr-Ca-Cu-O system with and without the addition of small amounts of lead. The kinetics of the phase transformation has been greatly affected by lead doping. The time required for the maximum formation of the 110 K phase is substantially reduced by the addition of lead. This phenomenon has been shown to be associated with the lead enhancing the nucleation and growth process of the 110 K phase and the diffusivity of calcium and copper.

42553 Effects of interfacial films on thermal stresses in whisker-reinforced ceramics. Hsueh, C.H. (9501970); Becher, P.F.; Angelini, P. *Journal of the American Ceramic Society (USA),* 71(11): 929-933 (Nov 1988).

Toughening of whisker-reinforced (or fiber-reinforced) ceramics by whisker pullout requires debonding at the whisker/matrix interface. Compressive clamping stresses, which would inhibit interface debonding and/or pullout, are expected in composites where the matrix has a higher thermal expansion coefficient than the whisker. Because such mismatch in thermomechanical properties can result in brittle composites, it is important to explore approaches to modify the thermal stresses in composites. As a result, the effects of a film at the whisker/matrix interface on the stresses due to thermal contraction mismatch upon cooling are considered in this study. Analysis of various properties of the thin film are considered for the whisker/matrix systems, in particular for SiC/Al_2O_3, SiC/cordierite, and SiC/mullite composites.

42554 Bistable optical information storage using antiferroelectric-phase lead lanthanum zirconate titanate ceramics. Land, C.E. (5659000). *Journal of the American Ceramic Society (USA)*, 71(11): 905-908 (Nov 1988).

A recently discovered photostorage effect in antiferroelectric-phase (AFE-phase) lead lanthanum zirconate titanate (PLZT) compositions appears to be particularly applicable to binary optical information storage. The basis for bistable optical information storage is that exposure to near-UV or visible light shifts the electric field threshold of the phase transition between the field-induced ferroelectric (FE) phase and the stable AFE phase in the direction of the initial AFE → FE phase transition. Properties of this photoactivated shift of the FE → AFE phase transition, including preliminary photosensitivity measurements and photostorage mechanisms, are presented. Photosensitivity enhancement by ion implantation is also discussed.

42555 Toughening behavior in whisker-reinforced ceramic matrix composites. Becher, P.F. (9501970); Hsueh, C.H.; Angelini, P.; Tiegs, T.N. *Journal of the American Ceramic Society (USA)*, 71(12): 1050-1061 (Dec 1988).

The toughening behavior of whisker-reinforced ceramics is analyzed in terms of a whisker bridging zone immediately behind the crack tip. This approach is consistent with microscopy observations which reveal that intact bridging whiskers exist behind the crack tip as a result of debonding of the whisker-matrix interface. The theoretical results based on both the stress intensity and the energy change introduced by bridging whiskers reveal the dependence of toughening upon the composition and matrix, interface, and whisker properties. Furthermore, the analytical models of whisker bridging accompanied by very limited pullout accurately describe experimental observations of the toughening behavior in several SiC-whisker-reinforced ceramics.

42556 Aminoborane polymers as precursors of C-N-B ceramic materials. Maya, L. (9501896). *Journal of the American Ceramic Society (USA)*, 71(12): 1104-1107 (Dec 1988).

Aminoborane polymers were prepared via condensation reactions between polyfunctional amines and either triethylborane or tris(dimenthylamino) borane. The products were characterized by chemical and spectroscopic analyses. The thermal degradation of these materials was studied to establish pyrolytic pathways and to evaluate their potential as precursors to C-N-B ceramic materials. The borane condensation products with 4,4'-methylenedipyrazole, o-phenylenediamine, and 3,3'-diaminobenzidine produced relatively high ceramic yields at 800°C, whereas that with diethylenetriamine decomposed into partially volatile oligomers.

42557 Annealing studies of highly doped boron superlattices. Jackman, T. E. (Microstructural Sciences Laboratory, National Research Council of Canada, Ottawa, Ontario K1A OR6, Canada (CA)); Houghton, D. C.; Jackman, J. A.; Denhoff, M. W.; Kechang, S.; McCaffrey, J.; Rockett, A. *Journal of Applied Physics (USA)*, 66(5): 1984-1992 (1 Sep 1989).

Coevaporation of B_2 O_3 during silicon molecular-beam epitaxy at growth temperatures (T_G) varying from 540 to 800 °C has been used to prepare superlattice structures (*pipi*'s) of varying boron concentration (3×10^{18} –3×10^{20} B cm^{-3}). The superlattices were subsequently subjected to various annealing procedures and the layers were examined by secondary ion mass spectrometry, electrochemical profiling, and cross-sectional transmission electron microscopy. A significant redistribution of boron was observed even before annealing for T_G >700 °C and high boron concentrations. In addition, significant oxygen was incorporated for T_G <700 °C, with a growth rate of 0.5 nm s^{-1} and a B_2 O_3 flux of 2×10^{13} cm^{-2} s^{-1}. After annealing, the boron diffusion coefficients were determined for the layers and found to vary significantly with T_G.

42558 Effect of oxygen stoichiometry on superconducting transition broadening under a magnetic field in $YBa_2Cu_3O_x$. Shi, D. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439 (US)); Boley, M. S.; Patel, M.; Kalia, R. K.; Vashishta, P. *Journal of Applied Physics (USA)*, 66(5): 2074-2078 (1 Sep 1989). DOE Contract W-31-109-ENG-38.

Resistivity as a function of temperature has been measured in magnetic fields up to 12 T for $YBa_2Cu_3O_x$ samples with oxygen concentration ranging from x=6.55 to 6.98. It has been observed that the oxygen concentration has a strong effect on the broadening behavior of the resistive transition in the magnetic field. The smearing of the transition region is due to a superconductive glassy state which arises from weakly coupled semiconductor-insulator-semiconductor junctions in a magnetic field, where the insulating region is a few angstroms thick twin boundary, and the flux creep model can be used to interpret the shape and the width of the resistive transition. For the well-oxygenated sample (x=6.98), the data yield $(dH_{c2}/dT)_{T=T_c}$ =−25.00 T/K for 90% transition resistivities at different fields, and −0.80 T/K for 10% transition curves. The broadening effect in field is decreased when the oxygen content is lowered to x=6.55 due to reduced thermally activated flux creep effects.

42559 High-temperature deformation of $YBa_2Cu_3O_{7-\delta}$. von Stumberg, A. W. (Materials and Components Technology Division, Argonne National Laboratory, Argonne, Illinois 60439 (US)); Chen, N.; Goretta, K. C.; Routbort, J. L. *Journal of Applied Physics (USA)*, 66(5): 2079-2082 (1 Sep 1989). DOE Contract W-31-109-ENG-38.

Steady-state flow stress of dense (99% of theoretical) polycrystalline $YBa_2Cu_3O_{7-\delta}$ has been measured in direct compression at temperatures between 870 and 980 °C in oxygen partial pressures of 0.03, 0.18, and 1.0×10^5 Pa for strain rates between 5×10^{-6} and 4×10^{-5} s^{-1}. The stress exponent was close to one, indicating that diffusional flow was the dominant deformation mechanism. The flow stress decreased with decreasing oxygen partial pressure, obeying a power law with an exponent of approximately 1/2 . The activation energy was about 800 kJ/mol at an oxygen partial pressure 1×10^5 Pa, but decreased to 600 kJ/mol at a pressure of 3×10^3 Pa.

42560 Structure of the interstitial oxygen defect in $La_2NiO_{4+\delta}$. Jorgensen, J. D. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439 (US)); Dabrowski, B.; Pei, S.; Richards, D. R.; Hinks, D. G. *Physical Review [Section] B: Condensed Matter (USA)*, 40(4): 2187-2199 (1 Aug 1989).

Using Rietveld refinement of neutron powder diffraction data, we show that the excess oxygen in $La_2NiO_{4+\delta}$ ($0.13<\delta<0.18$) is incorporated as an interstitial oxygen defect. The defect is located near the (1/4, 1) /4 ,(1/4) site in the orthorhombic *Fmmm* structure, which provides a favorable coordination to four La atoms but requires four nearby oxygen atoms to be displaced from their normal positions. The defect concentration determined from structural refinement agrees well with the overall oxygen stoichiometry determined by hydrogen reduction. For intermediate oxygen contents ($\delta\approx0.07$) the system separates into two phases with different defect concentrations. Structural data suggest that the nearly stoichiometric phase, $0<\delta<0.02$, incorporates excess oxygen by forming a different defect. Except for large differences in the solubility of the oxygen defect, $La_2NiO_{4+\delta}$ exhibits behavior remarkably similar to superconducting $La_2CuO_{4+\delta}$, suggesting that the oxygen defect structures are the same in both systems.

42561 Thermochemistry of rare-earth-metal-alkaline-earth-metal-copper oxide superconductors. Morss, L.R. (Argonne National Lab., IL (USA)); Sonnenberger, D.C.; Thorn, R.J. *Inorganic Chemistry (USA)*, 27(12): 2106-2110 (15 Jun 1988). DOE Contract W-31-109-ENG-38.

Enthalpies of formation of the perovskite-related oxides La_2CuO_4, $La_{1.85}Sr_{0.15}CuO_4$, and $YBa_2Cu_3O_y$(y = 6.25, 6.47, 6.69, and 6.93) have been determined at 298.15 K by solution calorimetry. Room-temperature stabilities of these compounds have been assessed in terms of the parent binary oxides and of the oxygen content. High-temperature (to 900°C) thermal behavior of $YBa_2Cu_3O_y$ has been used to determine thermodynamic properties (partial molal enthalpy, free energy, and entropy of oxygen) of this material in order to characterize the quenched state in relation to the high-temperature equilibrium state. The thermochemistry of oxygen has been used to interpret the relationship between the oxygen partial pressure and the defect chemistry in the nonstoichiometric phase of $YBa_2Cu_3O_y$. The relevance of the defect chemistry to conductivity is discussed. 34 references, 2 tables.

42562 Equivalence between the nonlinear σ model and the spin-(1/2 antiferromagnetic Heisenberg model: Spin correlations in La_2CuO_4. Manousakis, E. (Department of Physics, Center

for Materials Research and Technology Supercomputer Computations Research Institute, Florida State University, Tallahassee, Florida 32306 (US)); Salvador, R. *Physical Review [Section] B: Condensed Matter (USA),* 40(4): 2205-2216 (1 Aug 1989).

We study the continuum limit of the quantum nonlinear σ model in 2+1 dimensions and at finite temperature T using both Monte Carlo simulation on large-size lattices ($100^2 \times 8$ is our largest-size lattice) and saddle-point approximation. At zero temperature, we find the critical point g_c that separates the quantum disordered phase from the phase with spontaneous symmetry breaking (nonzero staggered magnetization). We calculate the model's renormalization group β function close to the critical point. Using the β function, we rescale the correlation lengths calculated at various values of the coupling constant (spin stiffness) and temperature and find that they all collapse on the same curve $\xi/a_\sigma = f(T/T_\sigma)$. Even though the lattice spacing vanishes, a finite unit of length a_σ and a temperature scale T_σ is generated via *dimensional transmutation.* Assuming that the nonlinear σ model and the spin-1/2 antiferromagnetic (AF) Heisenberg model are equivalent at low temperature, we relate the units a_σ and T_σ to the lattice spacing a_H and the AF coupling J of the Heisenberg model so that the correlation lengths obtained from the simulation of the two models agree. In order to achieve this agreement we find that (a) the spin-1/2 AF Heisenberg model should order at $T=0$ and (b) the relationship between the scales a_σ, T_σ and a_H, J is obtained, and $f(T/T_\sigma)$ can be accurately approximated by an exponential of T_σ/T below g_c.

42563 Crystallization of metal-oxide glasses in Bi-Sr-Ca-Cu-O systems. Shi, D. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439 (US)); Tang, M.; Boley, M. S.; Hash, M.; Vandervoort, K.; Claus, H.; Lwin, Y. N. *Physical Review [Section] B: Condensed Matter (USA),* 40(4): 2247-2253 (1 Aug 1989). DOE Contract W-31-109-ENG-38.

A crystallization study has been carried out for rapidly solidified Bi-Sr-Ca-Cu-O glasses with nominal compositions $Bi_2Sr_2Ca_2Cu_3O_x$, $Bi_2Sr_2Ca_3Cu_4O_x$, and $Bi_2Sr_2Ca_4Cu_5O_x$. A temperature-time-transformation diagram for the glass with nominal composition $Bi_2Sr_2Ca_2Cu_3O_x$ has been constructed, within which crystalline superconducting and nonsuperconducting phase regions are identified. Eutectic and primary crystallization have been found to occur during the annealing process in these metal oxides. Glass transition temperature T_g values, superconducting transition temperature values of crystallized products, and microstructural changes are measured and analyzed by differential thermal analysis, electrical resistivity, and magnetization shielding, x-ray diffraction, and scanning electron microscopy experiments. Also discussed are thermodynamics and kinetics of crystallization processes and the formation of the 110-K superconducting phase.

42564 Large, dispersive photoelectron Fermi edge and the electronic structure of $YBa_2Cu_3O_{6.9}$ single crystals measured at 20 K. Arko, A. J. (Los Alamos National Laboratory, P-10 Group, Los Alamos, New Mexico 87545 (US)); List, R. S.; Bartlett, R. J.; Cheong, S.; Fisk, Z.; Thompson, J. D.; Olson, C. G.; Yang, A.; Liu, R.; Gu, C.; and others. *Physical Review [Section] B: Condensed Matter (USA),* 40(4): 2268-2277 (1 Aug 1989). DOE Contract W-7405-ENG-82.

We have performed angle-integrated photoemission measurements at 20 K on well-oxygenated (T_c=92 K) single crystals of $YBa_2Cu_3O_{6.9}$ cleaved *n situ,* and find a relatively large, resolution-limited Fermi edge which shows large amplitude variations with photon energy, indicative of band-structure final-state effects. Some dispersion is seen even in our angle-integrated measurements. Our best estimate of $N(E_F)$ per Cu atom is that it is about 20% that of Cu metal with about a 20-80 mix of Cu 3*d* and O 2*p* orbitals. Dispersive and final-state effects are seen throughout the valence bands. The line shapes of the spectra as a function of photon energy are very well reproduced by band-structure predictions, indicating a correct mix of 2*p* and 3*d* orbitals in the calculations, while the energy positions of the peak agree with calculated bands to within ≈0.5 eV. We conclude that a Fermi-liquid approach to conductivity is appropriate.

42565 Strong-coupling corrections in high-T_c superconductors. Jaffe, J. E. (Department of Physics, Michigan Technological University, Houghton, Michigan 49931 (US)). *Physical Review [Section] B: Condensed Matter (USA),* 40(4): 2558-2561 (1 Aug 1989).

The problem of determining the normal-state specific-heat coefficient γ for high-T_c oxide superconductors is considered, and a method for empirically determining the strong-coupling corrections is proposed. This permits a direct estimate of $\gamma, \lambda, \langle\omega\rangle$, and other parameters from a few measured quantities, if isotropic Eliashberg theory is assumed to apply. On this basis, it appears that conventional electron-phonon strong coupling can account for the superconducting properties of $La_{1.85}Sr_{0.15}CuO_4$ but not those of $YBa_2Cu_3O_{7-\delta}$.

42566 Effect of Ce doping on the Cu charge in the electron superconductor $Nd_{2-x}Ce_xCuO_4$. Alp, E. E. (Argonne National Laboratory, Argonne, Illinois 60439 (US)); Mini, S. M.; Ramanathan, M.; Dabrowski, B.; Richards, D. R.; Hinks, D. G. *Physical Review [Section] B: Condensed Matter (USA),* 40(4): 2617-2619 (1 Aug 1989). DOE Contract W-31-109-ENG-38.

We have investigated the effect of Ce doping on the net Cu charge via x-ray absorption spectroscopy at the Cu *K* and the Ce L_3 edges. We conclude that Ce ions add electrons to the CuO_2 planes. It is most likely that this additional electron is injected into a band rather than being localized on each Cu site leading to Cu^{1+}. We observe that the amount of electron doping is larger than Ce concentration.

42567 Electronic Hamiltonian and antiferromagnetic interactions in La_2CuO_4. Annett, J. F. (Department of Physics, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801 (US)); Martin, R. M.; McMahan, A. K.; Satpathy, S. *Physical Review [Section] B: Condensed Matter (USA),* 40(4): 2620-2623 (1 Aug 1989).

A many-body Hamiltonian for La_2CuO_4 with *ab initio* parameters is solved numerically using embedded-cluster approximations. The results give an antiferromagnetic insulator with a 2–3 eV energy gap, consistent with spectroscopic measurements, NMR chemical shifts, and the spin-wave velocity. The Neel state has a significant frustration due to second-neighbor interactions, $J_2/J_1 \approx 5\%$–8%. Two competing states are found for holes introduced by doping, with primarily in-plane oxygen p_σ and out-of-plane oxygen p_z character.

42568 Raman scattering from superconducting gap excitations in $Tl_2Ca_2Ba_2Cu_3O_{10}$ single crystals. Krantz, M. C. (IBM Almaden Research Center, 650 Harry Road, San Jose, California 95120 (US)); Rosen, H. J.; Wei, J. Y. T.; Morris, D. E. *Physical Review [Section] B: Condensed Matter (USA),* 40(4): 2635-2638 (1 Aug 1989).

Raman spectra taken from several well-characterized superconducting $Tl_2Ca_2Ba_2Cu_3O_{10}$(2:2:2:3) single crystals (T_c=105 K) display the characteristic phonon spectrum of the 2:2:2:3 phase on top of a broad background continuum interpreted as electronic scattering. The electronic scattering continuum decreases substantially below T_c for frequency shifts of smaller than 400 cm^{-1}, indicating the formation of a superconducting gap. The gap does not show the expected abrupt onset but a linearly rising electronic scattering background similar to observations in $YBa_2Cu_3O_7$, possibly indicating a distribution of gaps or the presence of electronic excitations within the gap.

42569 Ba 4*d* core-level spectroscopy in the $YBa_2Cu_3O_{6.9}$ high-T_c superconductor: Existence of a surface-shifted component. Liu, R. (Ames Laboratory, Department of Physics, Iowa State University, Ames, Iowa 50011 (US)); Olson, C. G.; Yang, A.; Gu, C.; Lynch, D. W.; Arko, A. J.; List, R. S.; Bartlett, R. J.; Veal, B. W.; Liu, J. Z.; and others. *Physical Review [Section] B: Condensed Matter (USA),* 40(4): 2650-2653 (1 Aug 1989). DOE Contract W-7405-ENG-82.

Two sets of spin-orbit split Ba 4*d* core-level photoemission peaks were observed in a crystal of $YBa_2Cu_3O_{6.9}$. From constant final-state measurements taken as a function of kinetic energy, the low-binding-energy doublet is identified as a surface component. Possible origins of the surface shift are discussed.

42570 Systematics of transport critical-current-density hysteresis in polycrystalline Y-Ba-Cu-O. McHenry, M. E. (Exploratory Research and Development Center and Physics Division (P-10),

Los Alamos National Laboratory, Los Alamos, New Mexico 87545); Maley, M. P.; Willis, J. O. *Physical Review [Section] B: Condensed Matter (USA)*, 40(4): 2666-2669 (1 Aug 1989).

We have characterized the dependence of the transport critical current density of the polycrystalline $YBa_2Cu_3O_{7-x}$ superconductors on magnetic field and temperature history as a function of the applied field. Large hysteretic enhancements in the critical current density are observed upon changing the field direction. The enhancements are a strong function of the maximum applied field. Further, a novel field dependence of the critical current density is observed in field-cooled samples. The results indicate that currents circulating within the grains strongly influence the transport current.

42571 Magnetic field penetration depth of polycrystalline $(Y,Gd)Ba_2Cu_3O_7$, grain-aligned $YBa_2Cu_3O_7$, and single-crystal $Bi_2Sr_2CaCu_2O_8$. Mitra, S. (Ames Laboratory-U.S. Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011 (US)); Cho, J. H.; Lee, W. C.; Johnston, D. C.; Kogan, V. G. *Physical Review [Section] B: Condensed Matter (USA)*, 40(4): 2674-2677 (1 Aug 1989). DOE Contract W-7405-ENG-82.

The magnetic field penetration depths $\lambda(T)$ of the title compounds are determined from high-field (H=2.5 to 5 T) magnetization M versus applied magnetic field H isotherms, by use of a new method of data analysis in the region $H_{c1} \ll H \ll H_{c2}$ where M is reversible and linear in the logarithm of H. All of the $\lambda(T)$ results are consistent with behavior expected from BCS theory, indicating a nodeless superconducting order parameter. The magnitudes of $\lambda(0)$ are similar to reported values obtained using independent methods.

42572 Single-crystal neutron-diffraction investigation of the magnetic ordering of the high-temperature superconductor $ErBa_2Cu_3O_{7-\delta}$. Chattopadhyay, T. (Institut Laue-Langevin, Bote Postale No. 156X, 38041 Grenoble CEDEX, France (FR)); Brown, P. J.; Sales, B. C.; Boatner, L. A.; Mook, H. A.; Maletta, H. *Physical Review [Section] B: Condensed Matter (USA)*, 40(4): 2624-2626 (1 Aug 1989).

Neutron-diffraction experiments on single crystals of $ErBa_2Cu_3O_{7-\delta}$ ($T_c \cong 88$ K) show that Er moments order at about 500 mK with an antiferromagnetic structure with the wave vector k=(1/2,0,0). The magnetic moment of Er atoms is determined to be $4.8(2)\mu_B$ and is oriented perpendicular to the wave vector, i.e., along the *b* axis. This result differs from that of our previous powder investigations.

42573 Formation and properties of $2Tb_2O_3 \cdot Al_2O_3$. Jero, P.D. (9523328); Kriven, W.M. *Journal of the American Ceramic Society (USA)*, 71(11): C-454-C-455 (Nov 1988).

The compound $2Tb_2O_3 \cdot Al_2O_3$ was fabricated, and selected properties were investigated. The room-temperature X-ray diffraction pattern was indexed and the lattice parameters were calculated. Powder density was determined and used to calculate the number of molecules per unit cell. This allowed calculation of a theoretical density. The material was characterized with regard to thermal expansion and indentation hardness and toughness. It was found to exhibit a rapid and reversible polymorphic transformation at high temperature.

42574 Sinter-forging characteristics of fine-grained zirconia. Panda, P.C. (9520150); Wang, J.; Raj, R. *Journal of the American Ceramic Society (USA)*, 71(12): C-507-C-509 (Dec 1988).

Powder preforms of zirconia, containing 2.85 mol% yttria, were sinter-forged in simple uniaxial compression at 1400°C by applying constant displacement rates to the specimens. Shear and densification strains and the uniaxial stress were measured as a function of time. In contrast with alumina and silicon nitride, zirconia appears to densify by a dislocation mechanism. As a consequence, the densification rate is linked to the applied strain rather than to the applied hydrostatic pressure: the powder compact requires a critical amount of compressive strain to consolidate to full density, irrespective of the strain rate or the stress at which that strain is applied.

3606 Other Materials

Refer also to citation(s) 41537, 41551, 41826, 41827, 41843, 41917, 41931, 41937, 41942, 41943, 41946, 42178, 42300, 42345, 42445, 42471, 42520, 42530, 42531, 42539, 42556, 42743, 42935, 42948, 43017, 43019, 43247, 43310, 43362, 43650, 43651, 44132

42575 (AD-A–205525/9/XAB) **High electric field phenomena in insulation. Final report, 15 November 1986-14 November 1988.** Laghari, J.R.; Sarjeant, W.J. State Univ. of New York, Albany, NY (USA). 15 Jan 1989. 96p. Available from NTIS, PC A05/MF A01.

This study extends previous work to include electron radiation-induced changes in monoisopropyl biphenyl (MIPB)-impregnated polypropylene film as well as the effects of neutron/gamma radiation on dry polypropylene films. Effects that were quite similar were induced by both electron and neutron radiation on the properties of interest of the polypropylene films. Impregnation of the film with MIPB had a mitigatory effect on the degradation of the properties. This report also contains the results of a simultaneous electrical and thermal aging study of a capacitor-grade polypropylene film. The data obtained in this study was fitted to models that will enable realistic prediction of lifetimes under operating conditions. Keywords: Monoisopropyl biphenyl (MIPB) Polypropylene film. (jes)

42576 (AD-A–205975/6/XAB) **Mechanical behavior of PMMA-impregnated silica gels. Technical report.** Abramoff, B.; Klein, L.C. Rutgers–the State Univ., New Brunswick, NJ (USA). Dept. of Ceramics. 27 Feb 1989. 11p. (TR–1). Available from NTIS, PC A03/MF A01.

Silica xerogels were prepared from tetraethylorthosilicate with 50 vol.% open porosity. Methyl methacrylate monomer has been introduced into xerogel monoliths and polymerized with ultraviolet radiation. The fully infiltrated silica gel - PMMA composite has a bulk density of about 1.6 g/cm cubed. The resulting composite is lightweight and optically transparent. Elastic constants have been determined with ultrasonics. Flexure strengths have been measured in 4-point bending. The flexure strength of the composite is over 100 MPa in comparison to 20 MPa for the silica xerogel. The composite is designed for use at or below room temperature.

42577 (AD-A–206120/8/XAB) **Lubrication by a smectic liquid crystal.** Fischer, T.E.; Bhattacharya, S.; Salher, R.; Lauer, J.L.; Ahn, Y.J. Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Mechanical Engineering. Oct 1987. 8p. Available from NTIS, PC A02/MF A01.

The hydrodynamic aspects of lubrication by the smectic A liquid crystal octylcyanobiphyenyl (8CB) were investigated in a thrust bearing and in the concentrated ball on flat contact. Both bearings were run with a Newtonian mineral basestock for comparison and performed as expected; friction followed the Stribeck curve in the thrust bearing and the film thickness increased with (velocity) 2/3 in the elastohydrodynamic lubrication of the point contact. The lubricating behavior of the smectic liquid crystal is qualitatively different from that of the Newtonian fluid. Curves of friction coefficient vs. velocity x viscosity/load cannot be superimposed to form a Stribeck curve. The higher the load, the lower the velocity at which low friction is maintained, which is opposite to the behavior of Newtonian fluids. In concentrated contact (EHD lubrication) the smectic gives a friction coefficient that is constant with velocity and lower than the minimum value with the Newtonian fluid. The fluid film thickness varies with (velocity) 1/2.

42578 (AD-A–206160/4/XAB) **Selective pair luminescence of magnesium in gallium arsenide dissertation. Master's thesis.** Cavins, J.R. Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). Dec 1988. 191p. (AFIT/DS/ENP–88-2). Available from NTIS, PC A09/MF A01.

Photoluminescence (PL) and selective pair luminescence (SPL) studies were performed on vapor-phase epitaxial (VPE) GaAs. The GaAs included both undoped and Mg-ion-implanted samples. PL from the unimplanted samples indicated Zn was the dominant impurity with slight traces of C and Si also evident. This assignment was confirmed during SPL measurements of the ion implanted samples. The effect of the Mg implant on the relative intensities of the Mg-related SPL transitions was small but discernible. Photoluminescence of the ion-implanted materials showed strong Mg impurity spectra; however, the Zn impurity spectra was still dominant. Additionally, a parametric study was performed on the effects of temperature and laser pump intensity on the SPL spectra.

42579 (AD-A–206811/2/XAB) **Nonlinear optical techniques for thin-film growth and visible ultraviolet lasers. Final report, 30 September 1985-29 September 1988.** Eden, J.G. Illinois Univ., Urbana, IL (USA). Dept. of Electrical and Computer Engineering. 30 Nov 1988. 49p. Available from NTIS, PC A03/MF A01.

The goals of this AFOSR-supported program have been: (1) to investigate novel applications of nonlinear gas-phase photochemistry to the low-temperature growth of semiconductor and metal films, and (2) to develop new sources of stimulated emission at short wavelengths (lambda < 200 nm). This work has resulted in several significant accomplishments: (1) epitaxial semiconductor (Ge) films have been grown on GaAs at temperatures as low as 285 C by laser photochemical vapor deposition (LPVD); (2) NH3 has been demonstrated as a photosensitizer in the LPVD growth of films; (3) Ge/Si alloys have been grown by LPVD and analyzed; (4) the photochemical nature of laser-assisted MOCVD growth of GaAs on GaAs has been demonstrated; and (5) the excited state structure of Zn_2, Cd_2, Ar_2, and Ne_2 has been examined by laser spectroscopy.

42580 (AD-A–206932/6/XAB) **Band-structure engineering for ultralow-threshold laser diodes.** Ury, I.; Lau, K.Y. Ortel Corp., Alhambra, CA (USA). 1988. 7p. Available from NTIS, PC A02/MF A01.

It has been proposed that strained layer superlattices be used to reduce the effective mass of holes, thereby reducing the transparency electron density and subsequently the lasing threshold. In conventional bulk materials, the degeneracy of heavy and light hole bands at zone center means domination of the heavy hole band in hole occupation. It was known that, by applying strain to the crystal, the degeneracy can be broken such that under a biaxial compressive stress, the light hole band is lifted above the heavy hole band in the k-vector directions parallel to the applied strain. Since the heavy hole is five times heavier than the light hole, the resultant effective hole mass can be reduced by a factor of 5. The strain can be built in by growing lattice-mismatched InGaAs on GaAs substrate. Such lattice-mismatched epitaxial layers cannot be arbitrarily thick for it to be defect-free, the maximum thickness being only about 100 Angstroms.

42581 (AD-A–207063/9/XAB) **Characterization of MeV ion-implanted GaInAs/GaAs using x-ray and Raman techniques.** Wie, C.R.; Xie, K.; Kim, H.M.; Chen, J.F.; Burns, G. State Univ. of New York, Buffalo, NY (USA). Dept. of Electrical and Computer Engineering. 1988. 8p. Available from NTIS, PC A02/MF A01.

Pub. in SPIE, Vol. 946, 155-162(1988).

Lattice relaxation, elastic strain, and phonon shifts are studied in as-grown, MeV ion-implanted, and thermally annealed strained GaInAs layers on GaAs(001) substrates. The degree of lattice relaxation for the as-grown samples is discussed in terms of the measured in-plane lattice constants and the calculated critical thickness. For the 15-MeV Cl or 9-MeV P ion-bombarded GaInAs/GaAs, the beam induced elastic strains and beam induced phonon shifts are measured and discussed for samples with different degrees of initial relaxation. Thermal annealing on the as-grown and the ion-implanted GaInAs layers indicates a substantial thermal loss of indium in the thin surface layers and a full recovery of radiation damage in the GaInAs layers by 500 C.

42582 (AERE-R–13019) **Effects of radiation on intermediate-level waste forms. 1987 annual report.** Phillips, D.C.; McHugh, G.; Hitchon, J.W.; Wilding, C.R.; Spindler, W.E.; Winter, J.A.; Lyon, C.E.; Lindsell, P.H.R. UKAEA Harwell Lab. (UK). Materials Development Div.; Department of the Environment, London (UK). Jun 1988. 70p. (DOE-RW–88.079). Available from H.M. Stationery Office, London, price Pound 12.00.

The purpose of this programme is to determine the effects of radiation on the properties of intermediate level waste forms. The waste forms studied were RMA3, organic ion exchangers in cement: RMA5 mixed ion exchangers in vinyl ester polymer; RMA10 incinerator ashes in cement; and RMA11.1 combustible plutonium contaminated materials in cement. Of these RMA3 and 5 contain only B/γ activity whilst RMA10 and 11.1 contain α/B/γ activity. During the period covered by this report accelerated γ irradiation experiments have been performed on samples of RMA5 and RMA11.1 simulants and accelerated α irradiation experiments have been performed on samples of RMA10 and RMA11.1. Experiments have also been carried out on cement matrix materials. Data has been generated on gas evolution, mechanical integrity and dimensional stability of both the waste forms and their matrices. (Author).

42583 (CANMET–82-00106) **Final laboratory test results on the subject program.** Canada Centre for Mineral and Energy Technology, Ottawa, ON (Canada). [1989]. 9p. (MICROLOG–87-04010). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

This report presents the results of a series of tests on concretes made using fly ash from a number of Canadian power plants. The properties of the concrete, and the results of creep, drying shrinkage, and freeze-thaw durability are listed. All the ashes appear to give similar results with the exception of the Genisee (Alberta) sample, which exhibited high strength and modulus of elasticity, the lowest air content, the lowest creep and shrinkage, and the lowest durability. 5 tabs.

42584 (CONF-8511103–6) **Optical waveguides in plasma-polymerized organic materials.** Paul, P.H.; Kychakoff, G.; Robey, T.B. Stanford Univ., CA (USA). Dept. of Mechanical Engineering. 1985. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract FG03-85ER13393. From ICALEO international congress on the applications of lasers and electro-optics; San Francisco, CA (USA); 11-14 Nov 1985. Order Number DE89015311/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This letter describes the investigation of two procedures to control thin film refractive index: variation of monomer composition during deposition (to achieve transverse waveguide definition) and uv polymer modification (for lateral waveguide definition). Using these procedures, three-dimensional optical waveguides can be formed in plasma-polymerized films. 9 refs., 4 figs.

42585 (CONF-8611137–4) **Optical sensing system for thermoplastic composites manufacturing.** Howe, R.D.; Kychakoff, G. Stanford Univ., CA (USA). Dept. of Mechanical Engineering. [1986]. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract FG03-85ER13393. From International congress on applications of lasers and electro optics; 1 Nov 1986. Order Number DE89015318/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An optical sensing system for a new method of manufacturing thermoplastic composite material is presented. The manufacturing process and its sensing requirements are discussed. The system architecture and several sensors which have been developed are described. 4 refs., 3 figs.

42586 (DOE/ER/13930–1) **Particle deposition in granular media: Progress report.** Tien, Chi. Syracuse Univ., NY (USA). Dept. of Chemical Engineering and Materials Science. 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER13930. Order Number DE89016439/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This report summarizes the findings and results of the studies carried out under Grant No. DE-FG02-88ER13930 "Particle Deposition in Granular Media" during the period June 1, 1988 to date. A brief account of the project status is also included. Following is a brief description of the studies conducted during the period June 1, 1988 to date. (1) Modification of Granular Porous Media Models for Aerosol Deposition Studies. Previous investigations have shown that aerosol collection efficiencies in granular media predicted from using simple porous media models are significantly different from experiments (Tien, 1989). (2) Experimental Determination of Collection Efficiency of Granular Filtration. As part of the continuing effort, we have conducted experiments on granular filtration under well-controlled and defined conditions for both the initial period and the transient state. (3) Stochastic Simulation of Granular Filtration. During the past decades, much effort has been directed toward the formulation of simulation algorithms for aerosol deposition in porous media. Although the principle of the simulation is well established, its implementation can only be made under very restricted conditions (for example, under either inertialess or extremely high inertia conditions) because of the excessive computation required. During the past two years, we have explored the possible use of super computers for the simulation work. 10 refs., 2 figs., 1 tab.

42587 (ENEA-RT-COMB–88-05) **Superconductive ceramics obtained with sol-gel methods.** Arcangeli, G.; Masci, A.; Nardi, A.; Vatteroni, R.; Zondini, C.; Fava, R. ENEA, Casaccia (Italy). Dipt. Ciclo del Combustibile. Sep 1988. 26p. Order Number DE89761844/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Several sol gel routes have been considered, studied and developed to produce large quantities of granulates which can be processed to obtain ceramics having good superconducting characteristics. In the considered process, a mixture of commercial nitrates is atomized, at room temperature, in a solution (1:1) of Primene JMT and Benzene and a pale blue gel is suddenly formed from the starting elements. The granulates obtained are free flowing, very reactive and well suited for pressing. For their intrinsic characteristics they could be very good precursors for the production of large quantities of superconductive ceramics in different forms. The precipitated gel is dried, calcined, and pressed in the form of cylindrical pellets which are sintered up to 960°C. No grinding of different thermal treatments are needed. The sintered material has low electric resistance, shows a clear Meissner effect and has a transition temperature of between 91 and 95 K.

42588 (ETDE-mf–9911010) **Primary energy and air pollution balances of insulating materials.** Feist, W. Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Jun 1986. 34p. (In German). Order Number DE89911010/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01.

Details are given on the energy demand and pollutants emitted during the production of insulating materials. Investigations into the relation between energy consumption and air pollution are followed by an analysis of the actual primary energy conservation and environmental compatibility of thermal insulation. An assessment of the primary energy content of insulating materials, and primary energy conservation through thermal insulation, is followed by details on the production of insulating materials, and the operation of heating systems (thermal retrofitting of components, outer walls). Reference is made to the air pollution balances of insulating materials, as well as to the selection of economically efficient insulating thicknesses for retrofitted outer walls. (HWJ).

42589 (EXRC–634U577) **Microwave and radio-frequency curing of polymers.** Bilgen, E. Exergy Research Corp., Pointe Claire, PQ (Canada). 1988. 99p. (CE–02623). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The objectives of this study were to identify suitable polymers and their conventional curing systems, to estimate market potential for microwave/radio frequency curing of these selected materials, and to compare conventional and microwave/radio frequency technologies. In this report, the polymers produced and consumed in Canada and their conventional curing methods are reviewed, and potentially curable polymers are identified and their volumes determined. Energy requirements for polymer curing using various conventional curing methods are calculated, and costs for raw material and process-related preparation and relevant energy consumptions are determined. Based on the results of these studies, finished product costs by conventional curing methods are calculated using a cost and economics model. The microwave/radio frequency curing of polymers are reviewed, the characteristics of curable polymers discussed, and the energy requirements fro microwave/radio frequency curing are calculated. Finally, using these findings, a market penetration study is carried out to determine the potential Canadian market for the microwave/radio frequency curing of polymers. 54 refs., 14 figs., 41 tabs.

42590 (INIS-mf–11989, pp. 223) **A new, safer macroporous polyvinylpyridine resin for separating actinides using nitrate anion exchange.** Marsh, S.F. (Los Alamos National Lab. (LANL), NM (USA). Nuclear Materials Process Technology Group). Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

42591 (Juel–2268) **Investigation of kinematic demixing of polymer blend deuterated polystyrene (d-PS) and polyvinylmethylether (PVME) with neutron small angle scattering.** Yee Madeira, H.T. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung; Technische Hochschule Aachen (Germany, F.R.). Mar 1989. 74p. (In German). Order Number DE89796053/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The scope of this work is the investigation of the system PV ME/d-PS by small angle neutron scattering (SANS). The measurements were done with a pinhole-camera and a high resolution double crystal diffractometer and covered the resolution range from 10^{-3} to $3x10^{-2}$ A^{-1} and $2x10^{-5}$ to $6x10^{-4}$ A^{-1} respectively. As a basis for these investigations the phase diagram of a PVME/d-PS mixture was measured with SANS. The spinodal for different curve between stable and demixing region was obtained. For PVME with molecular weights M_w=60000 and d-PS with M_w=215103 the critical point is at the concentration PHI=0.2. From the spinodal and the structure factor the Flory-Huggins parameter CHI could be extracted as a function of temperature. It was found that CHI=0 for T_{comp}=135°C and CHI is independent of the molecular weight within the accuracy of the data, thus CHI may be associated with a local interaction parameter. The scattering experiments for the determination of the spinodal confirmed the mean-field behaviour of the critical scattering which was earlier found by Herkt-Maetzky and Schelten. Further, the time dependence of the structure factor in the miscibility gap was investigated. From the structure factors, specially from the position Q_{max} of their maxima, a characteristic length was extracted. (orig./RB).

42592 (KFK–4579) **Adaptation of spectral distribution of synchrotron radiation to X-ray depth lithography.** Maid, B.; Ehrfeld, W.; Hormes, J.; Mohr, J.; Muenchmeyer, D. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Mikrostrukturtechnik (IMT); Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. May 1989. 118p. (In German). Order Number DE89796039/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Plastic microstructures with extremly high aspect ratios can be fabricated by X-ray depth lithography with synchrotron radiation. In order to minimize the expenditure in terms of irradiation the spectrum of the synchrotron radiation source has to be adapted to the irradiation task. It is characterized by the height of the microstructure and the maximum admissible dose ratio permitting the resist to develop in the depth without destruction of the surface as a result of radiation damage. Expenditure in terms of irradiation is minimum if an ideal sharp cutoff filter, profiting from the maximum permissible dose ratio, filters out the long-waved portion of the spectrum without attenuating the intensity of the short-waved portion of the spectrum. By the example of a typical resist-developer system the location of the filter edge was determined at different structural heights for the Bonn synchrotron and the ELSA electron stretching facility (Bonn). To be capable of building the ideal sharp cutoff filter, the thickness of an absorber was adapted for different materials in such a way that the maximum permissible dose ratio was obtained. If a thin reflector foil is used which is hit by glazing radiation, the expenditure in terms of irradiation can be reduced because of the steeper filter characteristic of resists with small maximum dose ratios. The short-waved transmitted beam is used for irradiation, with the filter edge set by the angle between the foil and the beam. The technical feasibility of a reflection filter was demonstrated on the model of a reflector foil consisting of 30 nm titanium on 7.5 μm polyimide substrate by transmission measurements performed at different angles. (orig./HP).

42593 (OH/CR–88-164-K) **Investigation of concrete deterioration.** Caratin, H.; Keith, J.C.; Buchanan, E.V. Ontario Hydro, Toronto, ON (Canada). Civil Research Dept. 1988. 20p. (MICROLOG–89-02541). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke,

ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An investigation into the deterioration of concrete tower pads at three western Ontario transformer stations concluded that the lack of air-entrainment in the concrete is the cause of the deterioration. 11 figs., 2 tabs.

42594 (PB–89-177836/XAB) **Corrosion protection of prestressing systems in concrete bridges. Final report.** Perenchio, W.F.; Fraczek, J.; Pfeifer, D.W. Wiss, Janney, Elstner and Associates, Inc., Northbrook, IL (USA). Feb 1989. 36p. Available from NTIS, PC A03/MF A01.

The report reviews techniques and materials to provide enhanced corrosion protection for prestressing steel and its associated metallic hardware in pretensioned and post-tensioned concrete bridges. A year-long, accelerated corrosion test program on epoxy-coated strand, polyethylene duct, epoxy-coated steel duct, epoxy-coated anchorage hardware, grouts modified with silica fume and calcium nitrite, and heat-shrink tubing for sealing post-tensioning duct joints, together with traditional materials was undertaken on pretensioned and post-tensioned members. The use of newer corrosion-resistant duct materials and watertight duct joints was found to be essential since all three grout formulations were highly permeable to chloride at joints sealed with duct tape or after the traditional steel ducts corroded. Bond tests indicated that polyethylene duct and epoxy-coated steel duct can provide structurally composite behavior between the concrete and grout. Friction and abrasion tests demonstrated that a high coefficient of friction and abrasion damage may result if epoxy-coated strand is used in corrugated metal duct with a small radius of curvature.

42595 (PB–89-180210/XAB) **Breaking/cracking and seating concrete pavements. Final report.** Thompson, M.R. National Research Council, Washington, DC (USA). Transportation Research Board. Mar 1989. 49p. (TRB/NCHRP/SYN–144). Available from NTIS, PC A03/MF A01.

See also PB–88-214028. Library of Congress catalog card no. 88-51251.

This synthesis will be of interest to pavement designers, maintenance engineers, and others interested in reducing reflection cracking of asphalt overlays on portland cement concrete (PCC) pavement. Information is presented on the technique of breaking or cracking of the concrete pavement into small segments before overlaying with asphalt concrete. Asphalt concrete overlays on existing PCC pavements are subject to reflection cracking induced by thermal movements of PCC pavement. The report of the Transportation Research Board discusses the technique of breaking/cracking and seating of the existing PCC before an overlay as a means to reduce or eliminate reflection cracking.

42596 (PB–89-180384/XAB) **Investigation of concrete coating problems. Final report.** Abdul-Malak, M.A.U.; Price, D.A.; Fowler, D.W.; Meyer, A.H. Texas Univ., Austin, TX (USA). Center for Transportation Research. Nov 1987. 44p. (CTR–3-9-86-451-1F). Available from NTIS, PC A03/MF A01.

The objective of the research was to determine the causes and to find remedies for the darkening and/or peeling problems experienced with some types of concrete coatings. Other states were surveyed and field inspections of several locations in Texas districts were performed in order to identify possible variables which may cause darkening or peeling of coatings. The variables identified included type and thickness of coatings, level of concrete and coating textures, and condition of concrete surfaces. A test-panel program was then conducted in which the effect of each variable or a combination of variables was investigated. Recommendations are made that should reduce or eliminate many of the problems.

42597 (PB–89-185573/XAB) **Epoxy impregnation of hardened cement pastes for characterization of microstructure. Interim report.** Struble, L.; Byrd, E. National Bureau of Standards, Washington, DC (USA). Center for Building Technology. Nov 1986. 22p. (NBSIR–87/3504). Available from NTIS, PC A03/MF A01.

Methods were explored for drying of hardened cement paste prior to impregnation with epoxy, in order to polish for microscopic examination. All were shown to cause microcracking of the paste. An alternative method involves replacing pore water with ethanol, then replacing ethanol with epoxy. The method appears to minimize the occurrence of microcracks associated with drying.

42598 (PB–89-189138/XAB) **Mechanical-property enhancement in ceramic-matrix composites, April 1989. Interim report, 1 January-31 December 1988.** Freiman, S.W.; Cranmer, D.C.; Koczak, M.J.; Barsoum, M.; Fuller, E.R. National Inst. of Standards and Technology (IMSE), Gaithersburg, MD (USA). Ceramics Div. Apr 1989. 80p. (NISTIR–89/4073). Available from NTIS, PC A05/MF A01.

See also PB–88-232863.

The fiber-matrix interfacial properties of several glass and ceramic matrix composites have been determined using two indentation techniques and a single-fiber pull-out technique. An instrumented indenter was developed to improve the acquisition and analysis of the data. The effects of thermal-expansion mismatch were determined from three model composite systems containing large SiC monofilaments using the single-fiber pull-out test. An indentation push-out test was successfully used to determine the debond strength of a borosilicate matrix/SiC monofilament/carbon core material. A comparison of the various techniques for determining the fiber-matrix interfacial properties was conducted.

42599 (PB–89-189328/XAB) **Friability of spray-applied fireproofing and thermal insulations: field evaluation of prototype test devices.** Rossiter, W.J.; Roberts, W.E.; Mathey, R.G. National Inst. of Standards and Technology (NEL), Gaithersburg, MD (USA). Center for Building Technology. Mar 1989. 64p. (NISTIR–88/4012). Available from NTIS, PC A04/MF A01.

See also PB–89-131924.

The report describes results of the third and final phase of a study conducted for the General Services Administration (GSA) to develop a field-test method to measure the friability of spray-applied fireproofing and thermal-insulation materials. Field tests were conducted on 17 fibrous and 2 cementitious spray-applied materials to assess surface and bulk compression/shear, indentation, abrasion, and impact properties. The tests were performed using prototype devices developed in an earlier phase of the study. As expected, the field specimens displayed varying response to dislodgment or indentation in the tests. The field tests confirmed that the goal of the study had been achieved.

42600 (PB–89-862452/XAB) **Boron, metal, and aramid fiber reinforced plastics. January 1973-May 1989 (Citations from the Rubber and Plastics Research Association data base). Report for January 1973-May 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 155p. Available from NTISPC N01/MF N01.

Supersedes PB–87-850541.

This bibliography contains citations concerning properties and applications of boron, metal, and fiber-reinforced plastics. Discussions on improvements of electrical, thermal, and mechanical properties of plastics by boron, metal, and aramid fiber reinforcement are presented. Applications are considered in automotive, aerospace, electronics, marine, sports, and medical industries. (This updated bibliography contains 338 citations, 121 of which are new entries to the previous edition.)

42601 (PB–89-862965/XAB) **Plastics and elastomers: offshore applications. January 1973-November 1985 (Citations from the Rubber and Plastics Research Association data base). Report for January 1973-November 1985.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 190p. Available from NTISPC N01/MF N01.

This bibliography contains citations concerning the use of plastic and elastomer materials and products in survival equipment, enhanced-oil-recovery operations, corrosion-resistant coatings, and oil-spill recovery techniques. Glass-reinforced plastics, polymethyl methacrylates, acrylic resins, teflons, polyethylenes, polypropylenes, and nylons are among materials discussed. (This updated bibliography contains 320 citations, none of which are new entries to the previous edition.)

42602 (PB–89-862973/XAB) **Plastics and elastomers: offshore applications. December 1985-May 1989 (Citations from**

the Rubber and Plastics Research Association data base). Report for December 1985-May 1989. National Technical Information Service, Springfield, VA (USA). Jun 1989. 111p. Available from NTISPC N01/MF N01.

Supersedes PB-85-872406.

This bibliography contains citations concerning the use of plastic and elastomer materials and products in survival equipment, enhanced-oil-recovery operations, corrosion-resistant coatings, and oil-spill recovery techniques. Glass-reinforced plastics, polymethyl methacrylates, acrylic resins, teflons, polyethylenes, polypropylenes, and nylons are among materials discussed. (This updated bibliography contains 214 citations, all of which are new entries to the previous edition.)

42603 (PB-89-863757/XAB) **Polyethelene terephthalate (PET) scrap recycling. January 1973-May 1989 (Citations from the Rubber and Plastics Research Association data base). Report for January 1973-May 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 128p. Available from NTISPC N01/MF N01.

Supersedes PB-88-863584.

This bibliography contains citations concerning the recycling of polyethylene terephthalate products. Discarded bottles and household PET scrap are primary sources of this material. Recycling machinery, processes, and programs are discussed. Cable insulation, sheet films, foam products, and other products made from recycled polyethelene terephthalate are described. The impact recycling this material on resource conservation and waste-disposal problems is evaluated. (This updated bibliography contains 270 citations, 61 of which are new entries to the previous edition.)

42604 (PB-89-863955/XAB) **Metal matrix composites. January 1970-May 1989 (Citations from the US Patent data base). Report for January 1970-May 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 47p. Available from NTISPC N01/MF N01.

Supersedes PB-88-864780.

This bibliography contains citations of selected patents concerning fabrication methods, applications, and manufacturing equipment for metal-matrix composites. Various metal-matrix composites are examined, including aluminium, nickel, copper, titanium, boron containing, and fiber-reinforced composite materials. Techniques for welding, rolling, coating, and heat treating of metal matrix materials and components are discussed. Manufacturing methods in fabricating metal-matrix components for gas turbines, internal combustion engines, nuclear reactors, x-ray detectors, aerospace vehicles, and semiconductor/superconductor devices are presented. (This updated bibliography contains 96 citations, 11 of which are new entries to the previous edition.)

42605 (PB-89-864037/XAB) **Silicon-carbide-reinforced aluminum composites. January 1972-June 1989 (Citations from the International Aerospace Abstracts data base). Report for January 1972-June 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 135p. Available from NTISPC N01/MF N01.

Supersedes PB-88-864988; U.S. sales only.

This bibliography contains citations concerning the properties and fabrication of silicon carbide/aluminum composite materials. Fatigue behavior, reinforcement methods, dimensional stability, tensile properties, wear resistance, interface studies, pitting behavior, corrosion, and microstructure are among the properties discussed. Fabrication methods discussed include extrusion and hot rolling. (This updated bibliography contains 302 citations, 172 of which are new entries to the previous edition.)

42606 (PB-89-864250/XAB) **Solid Lubricants: graphite, polymers, fluorides, and general studies. February 1982-May 1989 (Citations from the COMPENDEX data base). Report for February 1982-May 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 131p. Available from NTISPC N01/MF N01.

Supersedes PB-88-857099.

This bibliography contains citations concerning the preparation, applications, properties, and testing of solid lubricants. Applications include bearings, gears, sliders, metal forming and cutting, and high and low-temperature usage. Some citations refer to lubrication of equipment used under vacuum conditions, such as for spacecraft. (This updated bibliography contains 289 citations, 96 of which are new entries to the previous edition.)

42607 (SAND-88-2448C) **A thermochemical model for shock-induced chemical reactions in porous solids: Analogs and contrasts to detonation.** Boslough, M.B. Sandia National Labs., Albuquerque, NM (USA). 1989. 23p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890811-26: 9. international symposium on detonation, 28 Aug - 1 sep 1989). Order Number DE89016180/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

There is a class of non-explosive energetic materials ("ballotechnics"), that undergo rapid shock-induced chemical reactions, but whose products contain no vapor that can cause a rapid expansion upon pressure release. The present paper presents a thermochemical model describing such reactions in terms analogous to detonation. By contrast, however, the chemical energy in ballotechnics is converted mostly to heat rather than work by the shock wave, and an unsupported reaction wave will decay. In the absence of volatiles, there are no large increases in pressure, specific volume, or particle velocity associated with ballotechnic reactions. Thus, experimental methods normally applied to high explosives are insensitive, and time-resolved temperature measurements are the most appropriate. The pressure-volume-velocity relationships are strongly dependent on small amounts of volatiles (such as water) when present, but the shock temperature is not. Thermochemically, the possibility of a true detonation in a volatile-bearing ballotechnic powder cannot be precluded. By the same arguments, geochemical detonations in volatile-saturated, supercooled magmas are possible. 28 refs., 8 figs., 3 tabs.

42608 (SAND-89-0763C) **Prediction and data analysis of current pulses from impact-loaded piezoelectric polymers (PVDF) [Polyvinylidene Flouride].** Anderson, M.U.; Graham, R.A.; Wackerbarth, D.E. Sandia National Labs., Albuquerque, NM (USA). 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890812-7: American Physical Society topical conference on shock compression of condensed matter, Albuquerque, NM (USA), 14-17 Aug 1989). Order Number DE89016178/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Piezoelectric polymers are useful in measuring shock compression waves. The resulting piezoelectric current is stress-rate dependent, providing detailed diagnostic information about the stress wave profile. Technique is presented to analyse, predict, and design a high quality impact experiment using Bauer polyvinylidene fluoride (PVDF). A data analysis program "PVDF-AUTO" has been developed, and written specifically for data analysis of direct impact experiments. Independent data analysis done by F. Bauer (Inst. St.-Louis) and "PVDF-AUTO" shows excellent agreement between the different data analysis techniques. Typical responses and data from which prediction of piezoelectric output can be carried out are presented. Typical gauge designs are shown. 8 refs., 4 figs.

42609 (SAND-89-1208C) **Hydrogen and deuterium profiling in polymers using light and heavy ion elastic recoil detection.** Green, P.F.; Doyle, B.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 28p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8906186-3: Materials Research Society materials analysis workshop, Albuquerque, NM (USA), 14-17 Jun 1989). Order Number DE89015887/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Silicon and helium elastic recoil detection (ERD) have been used to obtain concentration versus depth profiles of hydrogen (^{1}H) and deuterium (^{2}H) in polymers. Using helium ERD, a depth resolution of 100nm was achieved in polystyrene, whereas 30nm was achieved using silicon ERD. Polymers are in general susceptible to radiation damage and precautions are necessary in order to minimize this. These precautions are addressed. When helium ERD is used to obtain the yield versus energy profile, the conversion of this profile to one of concentration versus depth is relatively straightforward since the scattering cross sections for collisions between helium and ^{1}H or ^{2}H nuclei are independent of energy over typical incident energy ranges (2.3-3.0 MeV) used in these studies. With

the use of silicon ions, corrections for the energy dependence of the scattering cross section must also be made. A comparison of helium ERD measurements of diffusion in polymer systems is made with those obtained using other techniques. The agreement is excellent. 31 refs., 10 figs., 2 tabs.

42610 (SAND–89-1696C) **Second-order nonlinear optical devices in poled polymers.** Singer, K.D.; Holland, W.R.; Kuzyk, M.G.; Wolk, G.L.; Katz, H.E.; Schilling, M.L.; Cahill, P.A. Sandia National Labs., Albuquerque, NM (USA). 1989. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8908100–1: SPIE symposium on nonlinear optical properties of organic materials II, San Diego, CA (USA), 10-11 Aug 1989). Order Number DE89015842/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Guest-host poled polymer films have become an active area of research as potential candidates for second-order nonlinear optical and electro-optic devices. This interest derives mainly from their large nonlinear optical coefficients, ease of fabrication, and high optical quality. Progress has been rapid in producing stable, efficient materials, and in building demonstration devices. The second-order nonlinear optical properties arise from the orientational order induced in a collection of highly nonlinear molecules incorporated in a glassy polymer matrix. After reviewing the alignment physics, we present results of nonlinear optical measurements on a methacrylate polymer functionalized with a dicyanovinyl terminated azo dye. Device issues concerning nonlinear optical devices are described with particular attention to phase-matching. We present data on the demonstration of anomalous-dispersion phase matched second harmonic generation in dye solutions. We also present results on electro-optic modulators. 13 refs., 9 figs., 2 tabs.

42611 (SU/FAS–8610) **Performance of concrete panels exposed to ice abrasion at Navisivik, Baffin Island.** Aitcin, P.C; Laplante, P.; Perraton, D.; Gottheil, L.-A. Sherbrooke Univ., Quebec, PQ (Canada). Faculty of Applied Science. 1986. 46p. (MICROLOG–87-04000). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

The objective of this project was to fabricate twelve reinforced concrete panels of various composition, under controlled conditions, and then install them at an Arctic marine location where, over a period of time, the effects of ice abrasion could be determined and studied. The intent of the field measurements was to provide important information for the design of offshore platforms and other concrete structures in the Arctic. The use of supplementary cementitious materials with Portland cement (slag, fly ash, condensed silica fume) for the concretes was studied in the field and laboratory. It was found that strength results of test specimens related well to their mix compositions. As was expected, the steel fiber concretes have greater compressive and flexural strengths than the comparative non-fiber mixes. In the laboratory results for resistance to abrasion (least weight loss), the top ranking mix was the normal density reference concrete with steel fibers. The lowest weight losses were recorded for the fiber concretes, whether for the normal density group or the lightweight mixes. Generally, the normal density concretes performed better than those containing lightweight aggregates. In the normal density group of concretes, the silica fume and slag mixes did not perform as well as expected. Among the lightweight fiber concretes, the mix containing silica fume and fly ash was slightly better than the plain mix. 10 figs., 10 tabs.

42612 (UCRL–101244) **Aerosol penetration measurements through protective clothing in small scale simulation tests.** Bergman, W.; Garr, J.; Fearon, D.; Gerdner, P. Lawrence Livermore National Lab., CA (USA). Jun 1989. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8906192–1: 3. international symposium on protection against chemical warfare agents, Umea (Sweden), 11-16 Jun 1989). Order Number DE89015729/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have developed a new laboratory apparatus and technique to measure the penetration of aerosols through protective clothing. The unique feature of this apparatus is a cylindrical fabric holder that incorporates the complex aerodynamics of flow around protective clothing. Because of this feature, the test results from small patch samples in this apparatus can be used to predict aerosol penetration in full scale clothing. This apparatus has the potential for large time and cost savings in new suit development and in evaluating protective clothing against biological agents and chemical aerosols. 2 refs., 8 figs.

42613 Finite element welding computations using general purpose nonlinear analysis codes. VanGulick, L.A. (Los Alamos National Lab., Los Alamos, NM (US)). vp. of Advanced topics in finite element analysis. Cory, J.F.; Gordon, J.L. American Society of Mechanical Engineers, New York, NY (1988). (CONF-8806216–: Advanced topics in finite element analysis, 19-23 Jun 1988).

Parts being welded experience high local temperatures and severe thermal gradients which lead to large local stresses due to nonuniform thermal expansion and contraction. Unacceptable degradation of material mechanical properties, residual stresses, and changes in geometry can result. General purpose nonlinear finite element method analysis codes offer features which could facilitate their use for predicting welding temperatures, displacements, and stresses. A series of computations evaluating the use of general purpose codes for this purpose is described. Useful code features are identified and computational procedures to enhance solution accuracy suggested.

42614 Graphite as a picosecond laser activated opening switch. Chauchard, E.A. (Univ. of Maryland, College Park, MD (US)); Lee, C.H.; Huang, C.Y.; Malvezzi, A.M. vp. of Proceeding of a topical meeting on picosecond electronics and optoelectronics (technical digest). Optical Society of America, Washington, DC (1987). (CONF-870114–: 2. IEEE/OSA topical meeting on picosecond electronics and optoelectronics, 14-16 Jan 1987).

Highly oriented pyrolytic graphite exhibiting a high conductivity in the dark and a high resistivity when illuminated by intense laser light was used as an opening switch.

42615 An optically strobed sample and hold circuit. McConaghy, C. (9513035). vp. of Proceeding of a topical meeting on picosecond electronics and optoelectronics (technical digest). Optical Society of America, Washington, DC (1987). (CONF-870114–: 2. IEEE/OSA topical meeting on picosecond electronics and optoelectronics, 14-16 Jan 1987).

A GaAs sample and hold circuit with a 10-ps aperture time and 1-μs hold time has been built and used to sample single shot signals.

42616 Characterization of thin AlGaAs/InGaAs/GaAs quantum-well structures bonded directly to SiO_2/Si and glass substrates. Klem, J. F. (Sandia National Laboratories, Albuquerque, New Mexico 87185(US)); Jones, E. D.; Myers, D. R.; Lott, J. A. *Journal of Applied Physics (USA)*, 66(1): 459-462 (1 Jul 1989). DOE Contract AC04-76DP00789.

Strained GaAs/InGaAs/AlGaAs quantum-well structures grown on GaAs have beenremoved from their original substrates by a lift-off process and bonded directlyto glass or SiO_2-coated Si substrates. Both undoped and modulation-dopedstructures have been characterized before and after transfer by Hallmeasurements, variable temperature x-ray diffraction, and photoluminescence. Thebonded structures retain the high quality of the as-grown layers.

42617 Multilevel porous silicon formation. Tsao, S.S. (9511100); Guilinger, T.R.; Kelly, M.J.; Clews, P.J. *Journal of the Electrochemical Society (USA)*, 136(2): 586-587 (Feb 1989).

Oxidized porous silicon is the basis for one of the frontrunning silicon-on-insulator (SOI) fabrication techniques. Recently, it has also been demonstrated that porous silicon can be metallized to form silicon-on-conductor (SOC) structures. If a method for forming multilevel stacks of porous silicon layers (PSLs) can be developed, it should also be possible to combine the SOI and SOC techniques to form a buried, insulated conductor under single crystal silicon. In this communication, the authors report such a method for multilevel PSL formation.

42618 Cyclotron resonance of two-dimensional holes in strained-layer quantum well structure of (100)$In_{0.20}Ga_{0.80}As$/GaAs. Lin, S. Y. (Department of Electrical Engineering, Princeton University, Princeton, New Jersey 08544 (US)); Liu, C. T.; Tsui, D. C.; Jones, E. D.; Dawson, L. R. *Applied Physics Letters (USA)*, 55(7): 666-668 (14 Aug 1989).

Cyclotron resonance of the two-dimensional hole gas (2DHG) in the strained-layer quantum well structure of $In_{0.20}Ga_{0.80}As/GaAs$ is observed in far-infrared transmission measurements made at 4.2 K. The cyclotron mass of the 2DHG in the $In_{0.20}Ga_{0.80}As$ channel is $(0.191\pm0.008)m_e$ for a 2D hole density $p_{2D}=8.5\times10^{11}/cm^2$.

42619 On-line determination of alloy composition during ternary III/V molecular beam epitaxy. Tsao, J. Y. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800 (US)); Brennan, T. M.; Klem, J. F.; Hammons, B. E. *Applied Physics Letters (USA)*, 55(8): 777-779 (21 Aug 1989).

We describe a simple, new method for deducing surface alloy composition during ternary III/V molecular beam epitaxy. The method is based on on-line reflection mass spectrometry of the group V flux "reflected" from the surface during momentary terminations of individual group III fluxes.

42620 Microvoids in amorphous $Si_{1-x}C_x$:H alloys studied by small-angle x-ray scattering. Williamson, D. L. (Department of Physics, Colorado School of Mines, Golden, Colorado 80401 (US)); Mahan, A. H.; Nelson, B. P.; Crandall, R. S. *Applied Physics Letters (USA)*, 55(8): 783-785 (21 Aug 1989). DOE Contract AC02-83CH10093.

The microstructure of hydrogenated amorphous silicon-carbon alloys has been analyzed by small-angle x-ray scattering, infrared absorption, and density measurements. Decreasing density with C incorporation is due to microvoids about 0.6 nm in average radius, which are either approximately spherical in shape or randomly oriented nonspheres. The microvoid number density increases from about $5\times10^{19}/cm^3$ for *a*-Si:H to about $4\times10^{20}/cm^3$ for *a*-$Si_{0.7}$ $C_{0.3}$:H. The CH_3 species probably causes the enhanced microvoid formation in these alloys. A large fraction of the microvoid surfaces is not hydrogenated.

42621 Ruffling of nickel(II) octaethylporphyrin in solution. Alden, R.G. (Univ. of New Mexico, Albuquerque (USA)); Crawford, B.A.; Doolen, R.; Ondrias, M.R.; Shelnutt, J.A. *Journal of the American Chemical Society (USA)*, 111(6): 2070-2072 (15 Mar 1989). DOE Contract AC04-76DP00789.

Nickel(II) octaethylporphyrin (NiOEP) plays a central role in studies of the molecular properties of tetrapyrroles and tetrapyrrole-containing enzymes. NiOEP in noncoordinating solvents is found to be a mixture of planar and nonplanar, ruffled species. At 77 K in frozen solutions, the S_4 ruffled form is more prominent than at room temperature. The ruffled form is most prominent for laser excitation to the red of the Soret absorption maximum, suggesting that the ruffled form has a red-shifted Soret band. The presence of multiple forms coexisting in solution requires that normal coordinate analyses based on NiOEP spectra be reexamined.

42622 Electron-phonon coupling in superconducting $Ba_{0.6}K_{0.4}BiO_3$: A Raman scattering study. McCarty, K. F. (Sandia National Laboratories, Livermore, California 94551 (US)); Radousky, H. B.; Hinks, D. G.; Zheng, Y.; Mitchell, A. W.; Folkerts, T. J.; Shelton, R. N. *Physical Review [Section] B: Condensed Matter (USA)*, 40(4): 2662-2665 (1 Aug 1989). DOE Contract AC04-76DP00789.

Superconducting and nonsuperconducting phases in the $Ba_{1-x}K_xBiO_3$ system have been studied at temperatures down to 4 K by use of Raman spectroscopy. For superconducting $Ba_{0.6}K_{0.4}BiO_3$, an optical phonon at 348 cm^{-1} (43 meV) has the distinctive Fano line shape indicative of significant coupling between the phonon and a broad electronic continuum. For nonsuperconducting $Ba_{0.8}K_{0.2}BiO_3$, the same phonon is not observed to be coupled to the electronic states. Assignment ofthe 348-cm^{-1} peak to specific normal modes of vibration is discussed as is the similarity to the phonon at 340 cm^{-1} in $YBa_2Cu_3O_7$ that also exhibit selectron-phonon coupling.

42623 High-density structures and phase transition in an ionic model of H_2O ice. Demontis, P. (Department of Chemistry, University of Pennsylvania, Philadelphia, Pennsylvania 19104-6323 (US)); Klein, M. L.; LeSar, R. *Physical Review [Section] B: Condensed Matter (USA)*, 40(4): 2716-2718 (1 Aug 1989).

A self-consistent ionic model of water (protons and O^{2-} ions) has been used to explore the low-temperature, high-pressure properties of ice. Interionic interactions were calculated with the electron-gas model, and the self-consistent changes in the electronic structure of the oxide ions were modeled with Watson spheres. A phase transition is predicted at about 330 GPa from the observed, low-pressure, symmetric hydrogen-bonded cuprite structure to a fully ordered antifluorite structure. The transition pressure is higher than the 100-GPa estimate obtained from a molecular-dynamics study [Phys. Rev. Lett. 60, 2284 (1988)] that employed more approximate potentials.

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Refer also to citation(s) 42242

42624 (INIS-SU–104/A) **4. All-union conference on low temperature chemistry. Summaries of reports.** Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. 241p. (In Russian). (CONF-881257–: State Committee for Utilization of Atomic Energy meeting, Moscow (USSR), 4-10 Dec 1988). Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.

Individual papers are processed separately. (DLC)

42625 (INIS-SU–106) **Nuclear-hydrogen energetic and technology. Scientific-technical collection of papers.** Voprosy atomnoj nauki i tekhniki. No. 1. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 99p. (In Russian). Order Number DE89012197/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Individual papers are processed separately. (DLC)

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Refer also to citation(s) 41419, 41420, 41472, 41554, 41588, 41630, 41641, 41642, 41645, 41647, 41653, 41654, 41656, 41662, 41666, 41667, 41668, 41673, 41681, 41682, 41683, 41688, 41689, 41700, 41719, 41729, 41764, 41773, 41847, 42590, 42872, 42924, 43354, 43403, 43436, 43437, 43445, 43499, 43513, 43541, 43578, 43773, 43781, 43782

42626 (AD-A–205687/7/XAB) **Flow-injection analysis utilizing a spectrally segmented photodiode-array inductively coupled plasma-emission spectrometer. I. Microcolumn preconcentration for the determination of molybdenum. Technical report.** Furuta, N.; Brushwyler, K.R.; Hieftje, G.M. Indiana Univ., Bloomington, IN (USA). Dept. of Chemistry. 10 Feb 1989. 28p. Available from NTIS, PC A03/MF A01.

A flow-injection analysis (FIA) system incorporating a microcolumn of activated alumina was used for the determination of molybdenum by inductively coupled plasma-atomic emission spectrometry (ICP-AES). The transient signal resulting from the injection of molybdenum was determined by a spectrally segmented photodiode-array spectrometer. Linear calibration was established for molybdenum over a concentration range 0 - 1000 ng/ml. The detection capability was approximately 50 times better than offered by comparable continuous-nebulization systems. The detection limit for molybdenum was 0.2 ng/ml, and the relative standard deviations at 500 and 10 ng/ml were about 2 and 5%, respectively. The ability of the multichannel photodiode array spectrometer to correct for background shifts that occur during signal integration periods provided improved precision and accuracy. Application to the analysis of molybdenum in standard sea water (NASS-2) was demonstrated.

42627 (ANL/APS-TM–3, pp. 69-92) **Synchrotron-based spectroscopic and anomalous scattering studies of earth materials.** Borwn, G.E. Jr.; Waychunas, G.A. Argonne National Lab., IL (USA). Apr 1988. (CONF-880194–: Workshop on synchrotron X-ray sources and new opportunities in the earth sciences, 18-20 Jan 1988). In *Synchrotron x-ray sources and new opportunities in the earth sciences: Workshop report.* Order Number DE88009858/JAW. Available from NTIS, PC A07/MF A01.

Spectroscopic and scattering studies of natural materials and their synthetic analogues provide the information on structure and

bonding needed to address these research topics. However, because of a number of limiting factors (e.g. low concentration levels of certain important elements in earth materials, small sample volumes imposed by experimental restrictions, the need for high signal-to-noise ratio data, or low dimensionality of reaction sites at interfaces and grain boundaries), some of which act in concert, extremely high photon fluxes are needed for these studies. Currently, available spectroscopic and scattering methods using synchrotron radiation sources or laboratory x-ray sources can provide the type of information needed, but only for relatively high concentration samples which do not duplicate natural conditions. However, the situation should change dramatically with the commissioning of the Advanced Photon Source. This extremely intense and highly brilliant x-ray source will permit improved spectroscopic characterization of earth materials with low element concentrations and/or small volumes, and will lead to new classes of time-resolved experimental studies of transient phenomena, such as phase transitions and chemical reactions on mineral surfaces.

42628 (ANL/APS-TM–3, pp. 93-112) **X-ray fluorescence microprobe analysis.** Sutton, S.R.; Rivers, M.L.; Jones, K.W.; Smith, J.V. Argonne National Lab., IL (USA). Apr 1988. (CONF-880194–: Workshop on synchrotron X-ray sources and new opportunities in the earth sciences, 18-20 Jan 1988). In *Synchrotron x-ray sources and new opportunities in the earth sciences: Workshop report.* Order Number DE88009858/JAW. Available from NTIS, PC A07/MF A01.

Microanalytical techniques have played a major role in geochemical research. Electron microprobes, for example, have become the workhorses of essentially every geochemistry subdiscipline. A new generation of microprobe techniques, including secondary ion mass spectrometry (SIMS), particle-induced x-ray fluorescence (PIXE), nuclear reaction analysis (NRA) and synchrotron radiation-induced x-ray fluorescence (SRIXE), has emerged which allows the extension of this research to elements present at very low concentrations (<1 ppm). None of these techniques is optimum for all problems and the advantages of each depend on the particular application. The attractiveness of SRIXE lies in its capability for non-destructive, trace level analyses of a wide range of elements with high spatial resolution. In addition, the physics of photon interactions with matter is well understood so that quantification is relatively straightforward. Two fundamental complications in trace element experiments can be circumvented. First, high spatial resolution permits analyses on regions within individual mineral grains which are free from contaminating, solid and fluid inclusions. Second, the high elemental sensitivity offers the possibility of establishing the behavior of a large number of elements within a given geochemical system.

42629 (IAEA-AL–020) **Total evaporation measurements of plutonium with a Thermal Quadrupole Mass Spectrometer (THQ).** Fiedler, R.; Reichart, A.; Cappis, J. International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. Mar 1989. 11p. Order Number DE89634732/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

On site verification of isotopic distributions of samples prepared at nuclear reprocessing or fuel fabrication plants requires a measurement procedure which is as independent as possible from varying sample preparation procedures or sample concentrations. With conventional peak jumping data collection, mass fractionation effects are dependent upon the total mass of sample taken and amount of that sample evaporated. This requires the sample concentrations to be maintained in a narrow range to allow accurate correction of the fractionation. This effect can be reduced or eliminated if the ion currents or relative ion ratios are summed while the sample is totally evaporated. Measurement of the ion currents for a total evaporation of the sample using a single collector requires a mass spectrometer capable of rapidly scanning or peak jumping the isotopes of interest. This is accomplished using a quadrupole mass spectrometer. A software package written to give a special peak jumping sequence combined with incremental increases of evaporation (sample) filament current makes it possible to evaporate about 98% of the sample. The amount of Pu on the filament is 100 nanograms. Reproducibility of the 240/239 of 0.3% and accuracies of 0.2% (coefficients of variation) have been measured. The measurement is described and results of measurement of standards and actual samples are presented. (author).

42630 (INFO–0233) **Laboratory system for alpha particle spectroscopy.** Dean, J.R.; Chiu, N.W. Atomic Energy Control Board, Ottawa, ON (Canada). Mar 1987. 25p. Order Number DE89634689/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

An automated alpha particle spectroscopy system has beeen designed and fabricated. It consists of two major components, the automatic sample changer and the controller/data acquisition unit. It is capable of unattended analysis of ten samples for up to 65,000 seconds per sample.

42631 (INIS-mf–11483, pp. 11) **Neutron activation analysis for determination of induced radioactivity in concrete of nuclear reactors shielding.** Lavdanskij, P.A. (Joint Inst. for Nuclear Research, Dubna (USSR)); Nazarov, V.M.; Stephanov, N.I.; Frontasyeva, M. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

42632 (INIS-mf–11503, pp. 16-18) **Application of the 'Single Comparator' method to the determination of the elemental composition of renal stones by neutron activation analysis.** Mantel, M. (Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center); Pinte, G.; Piccot, D. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Summary only.

42633 (INIS-mf–11503, pp. 19-22) **Menkes disease, a copper disturbance syndrome. Neutron activation analysis for clinical trace element research determination of copper in chorionic villi.** Damsgaard, E. (Risoe National Lab., Roskilde (Denmark)); Heydorn, K.; Lavi, N. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Menkes disease, the kinky hair syndrome is a disturbance of copper metabolism transmitted as an x-linked recessive trait, leading to death in early childhood. In this work the copper concentration in biological tissue, chorionic villi, taken by biopsy from several high risk pregnancies, as well as from control samples, was determined by neutron activation analysis followed by a radiochemical separation of copper.

42634 (INIS-mf–11503, pp. 23-24) **Determination of the concentration of trace and doping elements in GaAs by neutron activation analysis.** Liu, R.S. (Tsing Hua National Univ., Hsinchu (China). Inst. of Nuclear Science); Chen, P.Y.; Yang, M.H.; Alfassi, Z.B. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Summary only.

42635 (INIS-mf–11503, pp. 25-27) **Preconcentration of trace elements from aqueous solution by copreciplitation with pyrollidine dithiocarbamate chelates followed by neutron activation analysis.** Alfassi, Z.B. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering); Lavi, N.; Lan, C.; Chung, C.; Yang, M.H. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order

Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
Transactions.; V. 15.
Summary only.

42636 (INIS-mf–11989) **Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.** Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. 223p. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Around 180 abstracts of invited lectures and poster presentations of the international analytical conference are presented in this book. They cover analytical applications throughout the fuel cycle and radioanalysis of manifold materials. Most of the abstracts are prepared separately for input in INIS and EDB. (RB).

42637 (INIS-mf–11989, pp. 223) **Laser-induced time-resolved spectrofluorometry and thermal lensing: Applications in the nuclear industry.** Decambox, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)); Delorme, N.; Mauchien, P.; Moulin, C. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.
Published in summary form only.

42638 (INIS-mf–11989, pp. 223) **The examination of actinide species in solution using a combined laser induced photoacoustic spectroscopy and electrochemistry system.** Cross, J.E. (UKAEA Harwell Lab. (UK). Chemistry Div.); Crossley, D.; Liezers, M.; McMillan, J.W.; Pollard, P.M.; Turner, S. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.
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42676 (INIS-mf–11989, pp. 223) **Application of ICP-MS to the measurement of long lived radionuclides in environmental samples.** Igarashi, Y. (National Inst. of Radiological Sciences, Nakaminato, Ibaraki (Japan). Div. of Radioecology); Shiraishi, K.; Kawamura, H.; Kim, C.; Takaku, Y.; Yamamoto, M. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.
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42677 (INIS-mf–11989, pp. 223) **Separation and determination of iodide, pertechnetate, and uranium from leaching solutions.** Jegle, U. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie); Mainka, E.; Ache, H.J. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.
Published in summary form only.

42678 (INIS-mf–11989, pp. 223) **Sensitivity enhancement and separation yield determination by neutron activation for activity measurement in media and environmental samples of nuclear reactors.** Niese, U. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)); Niese, S. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.
Published in summary form only.

42679 (INIS-mf–11989, pp. 223) **Ultrasensitive detection of technetium by resonance ionization mass spectroscopy.** Sattelberger, P. (Mainz Univ. (Germany, F.R.). Inst. fuer Kernchemie); Herrmann, G.; Riegel, J.; Rimke, H.; Ames, F.; Kluge, H.J.; Otten, E.W. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.
Published in summary form only.

42680 (INIS-mf–11989, pp. 223) **The elimination of matrix effects in the determination of fluorine in ivory by proton induced prompt gamma spectrometry.** Olivier, C. (Stellenbosch Univ. (South Africa). Dept. of Chemistry); Morland, H.J. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.
Published in summary form only.

42681 (INIS-mf–11989, pp. 223) **Extraction and spectroscopic studies of the compounds of uranium (VI) with some phenothiazines.** Puzanowska-Tarasiewicz, H. (Warsaw Univ., Bialystok (Poland). Dept. of Chemistry). Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.
Published in summary form only.

42682 (INIS-mf–11989, pp. 223) **New possibilities of radiochemical methods of analysis.** Shamaev, V.I. (Mendeleev Inst. of Chemical Technology, Moscow (USSR)). Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.
Published in summary form only.

42683 (INIS-mf–11989, pp. 223) **Ion exchange chromatography on a new form of tin dioxide for the isolation of Sr radioisotopes from fission products.** Stella, R. (Pavia Univ. (Italy). Ist. di Chimica Generale); Ganzerli Valentini, M.T.; Maggi, L. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9

Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

42684 (INIS-mf–11989, pp. 223) **Non-destructive determination of U and Pu in MOX-pellets and fuel-rods by gamma ray-induced energy-dispersive K-line.** Hoffmann, P. (Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich 8 - Anorganische Chemie und Kernchemie im Edward-Zintl-Institut); Pitz, N.; Lieser, K.H.; Dams, W.; Nelges, K.H. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

42685 (INIS-SU–89, pp. 129) **Atomic emission analysis of high-pure rare alkali metal salts using inductively coupled.** Sukhanovskaya, A.I. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Khimicheskikh Reaktivov i Osobo Chistykh Veshchestv, Moscow (USSR)); Krasil'shchik, V.Z.; Ehkgol'm, E.A.; Tsar'kova, V.S.; Voropaev, E.I.; Voronina, G.A.; Shlakova, E.Yu. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

Short Communication

42686 (INIS-SU–98, pp. 160) **Elementary analysis of superconducting low-temperature ceramics by ^{4}He ion elastic scattering technique.** Gusinskij, G.M.; Zavodchikov, V.M.; Rassadin, L.A.; Sokhoreva, V.V.; Yatis, A.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

Short Communication

42687 (INIS-SU–98, pp. 164) **Determination of impurity nitrogen content in titanium by nuclear backscattering technique.** Romanovskij, E.A.; Nguen, M.Kh.; Goryaga, N.G.; Galakhmatova, B.S.; Bespalova, O.V. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

Short note; 2 refs.

42688 (INIS-SU–98, pp. 166) **Determination of elementary composition of superconducting YBaCuO films by RBS technique.** Burdel', K.K.; Makarov, V.N.; Suvorov, A.V.; Chechenin, N.G. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

Short Communication

42689 (INIS-SU–100, pp. 162-166) **Problems of precision in the detection of the chemical elements in the environmental objects using the X-ray fluorescence and neutron activation analyses.** Iviev, L.S. (Leningradskij Politekhnicheskij Inst., Leningrad (USSR)); Kudryashov, V.I.; Goganov, D.A.; Serebryakov, A.S.; Plavko, A.V. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The experimental precisions of determining impurity concentrations in water, air and soil achieved during elementary analysis using X-ray fluorescence and neutron activation analyses, are considered. The results obtained during X-ray fluorescence analysis using the MECA 10-44 spectrometer with the X-ray tube as the initial radiation source are compared with the data of analysis using the X-ray spectrometer with radionuclide sources cadmium 109-and americium-241 as well as the data of neutron activation analysis. 3 figs.; 1 tab.

42690 (INIS-SU–106, pp. 72-75) **Nuclear-physical study of material-hydrogen.** Khabibullaev, P.K.; Valiev, A.N.; Ketko, A.Ya.; Kiseleva, E.V.; Mun, G.V.; Skorodumov, B.G.; Ulanov, V.G.; Yatsevich, I.O. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Nuclear-hydrogen energetic and technology. Scientific-technical collection of papers.* Order Number DE89012197/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 1.

Two nuclear-physical methods of study of concentration hydrogen isotopes distributions in thickness of studied materials are described and compared. Both methods are based on recording energy spectra of the interaction products in one case of cyclotron accelerated protons (E_p=20 MeV), and in another one of generator monochromatic neutrons (E_p=14 MeV) qith hydrogen containing in the material. The hydrogen detection limit for the first method is 10^{-5} at.H/at.M (where M is a metal) and for the second one - 10^{-1} at.H/at.M and 10^{-3}at. D,T/at.M, respectively, for deuterium and tritium. It is shown that the methods of hydrogen grading using nucleons can be successfully used for studying physical phenomena occuring in the substance with hydrogen participation. While studying hydrogen highly absorbing materials the neutron scattering method is preferable. 6 refs.; 3 figs.

42691 (KURRI-TR–311) **Report of the specialists' workshop on phase transition studies on hydrogen-bonded crystals by neutron and X-ray diffractometries.** Tokunaga, M. (Hokkaido Univ., Sapporo (Japan). Faculty of Science); Shibuya, I. (eds.). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jan 1989. 56p. (In Japanese). (CONF-8812101–: Specialists' workshop on phase transition studies on hydrogen-bonded crystals by neutron and X-ray diffractometries, Kumatori (Japan), 12-13 Dec 1988). Order Number DE89906638/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The report carries a total of 15 studies on hydrogen-bonded crystals made by means of neutron/X-ray diffraction which were presented at a technical study meeting held on December 12 and 13, 1988, at the Research Reactor Institute of Kyoto University. The report covers 'introduction', 'linear relation between transition temperature and hydrogen-bond length in KDP type crystals', 'X-ray study of crystal structure under high pressure in DKDP', 'crystal structure of ADP in the paraelectric phase', 'crystal structure of Rochelle salt in the paraelectric phase', 'distortion of AsO_4 in KDA', 'study of phase transition in KDP family by dielectric dispersion', 'dielectric relaxation and phase transition in ice Ih', 'Raman scattering study of KDP', 'mechanism of phase transition in KDP by Raman scattering study under high pressure-reinvestigation of the Peercy's conclusion', 'localized modes of proton in KDP', 'hyper-Raman scattering study of hydrogen-bonded crystals', 'phase transition of CDP', 'the 180deg law in phase diagram', and 'comments'. (N.K.).

42692 (LA-UR–89-2423) **Coherent anti-Stokes Raman spectroscopy of shock-compressed liquid oxygen.** Schmidt, S.C.; Moore, D.S.; Shaw, M.S.; Johnson, J.D. Los Alamos National Lab., NM (USA). [1989]. 5p. Sponsored by U.S. DOE Defense Programs.

DOE Contract W-7405-ENG-36. (CONF-890812–5: American Physical Society topical conference on shock compression of condensed matter, Albuquerque, NM (USA), 14-17 Aug 1989). Order Number DE89015411/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Vibrational spectra of liquid oxygen, shock compressed to several high-pressure/high-temperature states, were obtained using single-pulse multiplex coherent anti-Stokes Raman scattering (CARS). The experimental spectra were compared to synthetic spectra calculated using a semiclassical model for the CARS intensities and best fit vibrational frequencies, peak Raman susceptibilities, and Raman linewidths. Up to the maximum shock pressure of 9.6 GPa, the vibrational frequencies were found to increase monotonically with pressure. An empirical fit, which could be used as a pressure/temperature/frequency calibration standard, showed that the Raman frequency shifts could be accurately described by linear pressure and temperature dependences. Above ≈9 GPa, the liquid oxygen opacity at 632.8 nm increased rapidly, presumably because of proximity (collision)-induced absorption. Calculations showed that the induced absorption did not resonantly enhance the CARS spectra, but did attenuate the laser beams and the CARS signals. 33 refs., 2 figs., 1 tab.

42693 (LA-UR–89-2540) **Novel lutetium spectroscopic interactions via cw RIMS [Resonance Ionization Mass Spectrometry].** Fearey, B.L.; Miller, C.M. Los Alamos National Lab., NM (USA). [1989]. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890618–4: NICOLS '89: 9th international conference on laser spectroscopy, Bretton Woods, NH (USA), 18-23 Jun 1989). Order Number DE89015289/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Novel spectroscopic interactions of argon-ion laser enhanced resonance ionization of lutetium are observed and discussed; these include line-narrowing, non-linear power dependences and anomalous optical pumping effects of the hyperfine transitions. In addition, isotopically saturation dip spectra are observed and presented, allowing for precise determination of hyperfine constants of rare isotopes. 12 refs., 2 figs.

42694 (MRP/MSL–84-134(IR)) **IAEA thorium gamma-ray calibration material. Application of high resolution spectrometry to monitor thorium/uranium ratio.** Smith, C.W.; Grasty, R.L. Canada Centre for Mineral and Energy Technology, Ottawa, ON (Canada). Mining Research Labs. Oct 1984. 28p. Order Number DE89634690/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A technique was developed for rapid measurement of the equivalent thorium to equivalent uranium ratio of thorium-rich material. High resolution gamma-ray spectrometry was used to measure the ^{208}Tl to ^{214}Bi activity ratio from the relative intensities of their corresponding photopeaks at 583 and 609 KeV. Owing to the proximity of the energy of these emissions, the intensity ratio was independent of variations in the geometry and absorption properties of the sample. The procedure was applied to test rock samples collected from a britholite vein associated with the Oka, Quebec Carbonatite for suitability as source material for an IAEA interlaboratory gamma-ray thorium standard, which was required to have a minimum equivalent thorium to equivalent uranium ratio of about 100. Following crushing to approximately -100 mesh equivalent uranium and thorium were measured by gamma-ray spectrometry and found to be 0.0283 ± 0.0007% AND 2.74 ± 0.06% respectively thereby meeting the IAEA requirements.

42695 (NUTP–3E) **Radioanalytical methods manual.** Chiu, N.W.; Dean, J.R. Canada Centre for Mineral and Energy Technology, Ottawa, ON (Canada). 1986. 60p. Order Number DE89634685/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

This Radioanalytical Methods manual is comprised of 12 chapters. It includes a review of the pertinent literature up to the end of 1982 pertaining to the measurement of the radioactive species listed under the terms of the contract. Included is methodology recommended for the decompositions of soils, tailings, ores, biological samples and air filters. Detailed analytical methodology for the measurement of gross alpha, gross beta, gross gamma, uranium, radium-226, radium-228, lead-210, thorium-232, thorium-230, thorium-228, total thorium, radon-222, radon-220 and radon-219 is presented.

42696 (ORNL/M–500, pp. 11-18) **Interactions of solvents, solutes, and surfaces: adsorption and supercritical extraction.** Cochran, H.D.; Byers, C.H.; Scott, C.D. Oak Ridge National Lab., TN (USA). 1988. In *Research programs for Division of Chemical Sciences, Office of Basic Energy Sciences, Department of Energy.* Order Number DE89003693/JAW. Available from NTIS, PC A03/MF A01.

Fundamental experimental and theoretical studies are focused on relating macroscopic properties of mixtures to intermolecular interactions and molecular correlation functions for the highly asymmetric systems characteristic of extraction by supercritical fluids and adsorption from supercritical fluids. Experimental studies of solubility of transition metal fluorides in supercritical CF_4 are under way. Complementary theoretical studies based on distribution function theories from statistical mechanics are continuing; these efforts have already led to new models for solubility and other equilibrium properties. A new technique for measuring adsorption rates from supercritical mixtures based on a surface acoustic wave transducer is being evaluated. Future experiments are under consideration for direct measurement of molecular correlation functions of supercritical mixtures using neutron scattering.

42697 (ORNL/M–500, pp. 19-28) **Chemical and physical principles in multiphase separations.** Byers, C.H.; Scott, T.C.; Basaran, O.A. Oak Ridge National Lab., TN (USA). 1988. In *Research programs for Division of Chemical Sciences, Office of Basic Energy Sciences, Department of Energy.* Order Number DE89003693/JAW. Available from NTIS, PC A03/MF A01.

This program is comprised of several fundamental studies which address the issue of the use of electromagnetic fields to enhance the efficiency of multiphase separation processes. The primary focus of the program is upon improving mass transfer performance in liquid-liquid solvent extraction by utilizing theoretical insight gained from an in-depth analysis of electric field effects in dispersed liquid systems. A secondary thrust has been initiated to pursue investigation of potential applications of magnetic field interactions in macromolecular separation schemes.

42698 (PNL–6500-Pt.4, pp. 16-18) **Development of capillary zone electrophoresis-mass spectrometry.** Udseth, H.R.; Smith, R.D. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

Recently we described the first on-line combination of CZE with mass spectrometry, which also represented the first reported direct combination of any electrophoretic separation technique with mass spectrometry. This development was based upon the recognition that both ends of the CZE capillary did not have to be immersed in buffer reservoirs, as conventionally practiced. This provided a basis for new detection methods in which the electro-osmotically induced flow could be analyzed at the column terminus. The strong electro-osmotic flow in CZE, which results from the strong zeta potential of most amenable capillary surfaces, is sufficiently large under many conditions to result in elution of ions having both positive and negative electrophoretic mobilities in a single separation. Nonaqueous buffers also allow compounds to be separated which are somewhat less polar than feasible in aqueous systems, effectively providing a range of applications which should overlap with those of SFC.

42699 (PNL–6500-Pt.4, pp. 19-21) **Ultra-trace isotopic analysis by double-resonance ionization spectroscopy.** Bushaw, B.A.; Gerke, G.K. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

Lasers have unique properties that may be used to improve both sensitivity and selectivity in analytical measurements. Pacific Northwest Laboratory is developing a number of laser-based methods for the measurement and identification of trace levels of radionuclides and environmentally hazardous materials. Over the last year we have improved the techniques of continuous-wave double-resonance ionization mass spectrometry, increasing both sensitivity

and selectivity in the spectroscopic process to the point where it may be considered a near ideal atom counter, providing ionization efficiencies approaching unity and isotopic abundance sensitivities in excess of 10^{10}. With completion of the excitation process development, we have shifted emphasis in the program from spectroscopic studies to the development of methodologies for the analysis of small discrete samples. A miniature graphite furnace has been incorporated into the system for the atomization of solid and aqueous samples. Using this furnace, instrumental detection limits of 10^{-17} grams have been demonstrated for rare isotopes of barium.

42700 (PNL–6500-Pt.4, pp. 25) **Electron emission from solids.** DuBois, R.D. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

An apparatus for studying the doubly differential electron emission from various solid (foil) targets is being constructed. This apparatus will consist of an ultra-high-vacuum system containing a precision manipulator for foil targets. A rotatable time-of-flight electron analyzer will be used to detect electrons emitted during projectile ion-target interactions. To date, an ultra-high-vacuum chamber and pumps have been purchased. The chamber stand and hoist for the lid have been constructed. A double-walled magnetic shield has been designed and is on order. It is anticipated that during the next year the chamber will be fully assembled and a time-of-flight electron detector will be designed, constructed and installed, at which time preliminary testing will begin.

42701 (PTB-W–37, pp. 65-78) **Process for producing test gases.** Wilde, K. (Linde AG, Unterschleissheim (Germany, F.R.). Werksgruppe Technische Gase). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Waerme. Jun 1988. (In German). (CONF-8712127–: 67. PTB-seminar on state and development of gas calorimetry and charging for heating gas, Braunschweig (Germany, F.R.), 10-11 Dec 1987). In *State and development of gas calorimetry and charging for heating gas. Proceedings.* Order Number DE89795859/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01.

In gas measurement technology, test gases are required above all for the calibration of physical measurement systems. In the introduction, the terms for gas mixture/test gases according to VDI 3490 sheet 1 are explained. The most important manufacturing processes for test gases in pressurized gas bottles, i.e. the volumetric, the manometric and the gravimetric methods are described and the advantages and disadvantages are compared. To provide a test gas, apart from mixing the gases together, the following boundary conditions must be observed: technical feasibility, selection of container and valve, pretreatment of container and analytical quality assurance. (orig./HW).

42702 (SKB-TR–88-24) **Fission product concentration profiles (Sr, Xe, Cs and Nd) at the individual grain level in power-ramped LWR fuel.** Forsyth, R.S.; Mattsson, O.; Schrire, D. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Dec 1988. 44p. Order Number DE89796489/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

In addition to dissolution of the UO_2 matrix, the corrosion of spent nuclear fuel in groundwater appears to occur, at least in the short term, by the rapid dissolution of fission product phases formed during reactor irradiation, and by selective attack at zones or segregations in the fuel enriched in fission products. The Electron Probe Micro-Analysis (EPMA) technique offers the possibility of identifying and analyzing such phases and segregations in spent LWR fuel, although the small amounts expected to be present, and the background radiation, present a significant analytical challenge. This report describes preliminary work performed to examine the application of the EPMA technique to this problem. The fuel specimen examined had been power-bumped to a linear power rating somewhat higher than those generally experienced by commercial LWR fuel, so that fission product mobility had been enhanced. Steep concentration gradients for xenon and cesium within individual fuel grains, probably due to grain boundary sweeping during grain growth, were detected and measured. With changes in the analytical technique, it is possible that even strontium could be determined. (orig.).

42703 **Electrodialytic membrane suppressor for ion chromatography.** Strong, D.L. (Texas Tech Univ., Lubbock (USA)); Dasgupta, P.K. *Analytical Chemistry (USA),* 61(9): 939-945 (1 May 1989). DOE Contract FG05-84ER13281.

A dual membrane helical electrodialytic suppressor is described. A platinum-wire-filled tube made of Nafion perfluorosulfonate membrane, inserted in another perfluorosulfonate membrane tube, is coiled into a helix. The helical assembly is inserted within an outer jacked packed with granular conductive carbon. An alkaline eluent, e.g., NaOH or Na_2CO_3, flows in the annular channel between the two membranes and pure water flows through the inner membrane and the outer jacket, countercurrent to the eluent flow. A dc voltage (typically 3-8 V) is applied across the carbon bed and the platinum wire. Na^+ in the eluent migrates to the cathode compartment resulting in water as the suppressed effluent and NaOH as the catholyte effluent. The dual membrane design prevents direct electrode contact with the eluent; bubble induced noise in the suppressed eluent due to any residual gas is eliminated or minimized with a microporous gas-permeable membrane tube or by applying sufficient back pressure to the detectors exit. Up to 500 μequiv of NaOH/min can be quantitatively suppressed with a membrane length of 50 cm and a band dispersion of 106 μL (20-μL sample). With typical eluents, the system permits detection limits in the low-parts-per-billion level for most common anions.

42704 **Optimization of sample size and sample volume in preparative liquid chromatography.** Katti, A. (Univ. of Tennessee, Knoxville (USA)); Guiochon, G. *Analytical Chemistry (USA),* 61(9): 982-990 (1 May 1989).

The semi-ideal model of chromatography has been used to calculate the influence of the sample amount of volume of a binary mixture on the production rate achieved in preparative liquid chromatography. The optimum conditions have been found to depend highly on whether one is interested in the production of the first or second eluted component. At low separation factors the sample volume influences the production rate of the first component significantly and low volume, concentration injections should be used. At large separation factors, the sample volume is of less importance for 1/3 and 1/9 mixtures but of more importance for 3/1 and 9/1 mixtures. For the second component, the sample volume influences the production rate to a lesser extent than for the first one; however, low volume, concentrated samples give the higher production rates. The maximum production rate for component 1 occurs at very high sample loading so that the displacement effect concentrates and compresses the band. In contrast, the maximum production rate of component 2 occurs when the front of its band pushes against the rear boundary of the first component, with little band overlap. If one yields exceeding 80% for component 1, it may be necessary to accept production rate losses ranging from 10% to 40%.

42705 **Low-level detection of metal atoms by multiphoton ionization in a low-pressure flame sampling gel.** Blazewicz, P.R. (Oak Ridge National Lab., TN (USA)); Whitten, W.B.; Ramsey, J.M. *Analytical Chemistry (USA),* 61(9): 1010-1013 (1 May 1989). DOE Contract AC05-84OR21400.

The authors are using a low-pressure sampling cell to extract species from an air/acetylene analytical burner. Single-color multiphoton ionization by a pulsed dye laser is used for the sensitive detection of atomic species in the cell. The dye laser excites one of the low-lying two-photon accessible states, and absorption of an additional photon efficiently ionizes the excited state. Excellent detection limits are reported for sodium, lithium, calcium, and copper (Na, 20 pptr (parts per trillion); Li, 100 pptr; Ca, 7 ppb; Cu, 25 pptr). No signals were observed for neodymium of aluminum, presumably due to the consumption of the atoms to form molecular species in the cell. Potassium shows a much poorer detection limit and a quadratic dependence of signal on concentration.

42706 **High-resolution fourier transform spectrometer to identify the rotational structure of the $B^2\Sigma_u^+$-$X^2\Sigma_g^+$ transition of N_2^+(0,0) in a helium inductively coupled plasma.** Manning, T.J. (Los Alamos National Lab., NM (USA)); Palmer, B.A.; Hof, D.E. *Analytical Chemistry (USA),* 61(9): 1052-1056 (1 May 1989).

The Los Alamos Fourier Transform Spectrometer (LAFTS) housed in a 3360-ft^2 building, is the highest resolution visible and ultraviolet FTS in the world. The instrument is currently operating with single pass optics allowing for a maximum resolution of 0.0026 cm^{-1} (0.023 pm at 300 nm). The interferometer is housed within a 14 ft by 7 ft vacuum tank (30 m Torr achieved) and utilizes two entrance ports for experiments. The FTS sits on a 4 ft by 10 ft NRC vacuum compatible optical table isolating the instrument from vibration. This paper presents a low flow, laminar flow, atmospheric pressure helium ICP torch. Nitrogen is seeded into the helium plasma and the emission from N_2^+ is analyzed by using the Los Alamos Fourier transform spectrometer.

42707 Synchrotron microtomography of supported catalysts. Nichols, M. C. (Materials Department, Sandia National Laboratories, Livermore, California 94550 (US)); Kinney, J. H.; Johnson, Q. C.; Saroyan, R. A.; Bonse, U.; Nusshardt, R.; Pahl, R. *Review of Scientific Instruments (USA),* 60(7): 2475-2477 (Jul 1989). DOE Contract W-7405-ENG-48.

Synchrotron microtomography is a new technique which is capable of elemental, chemical, and structure sensitive imaging in three dimensions at resolutions better than 15 μm. This paper describes the first application of this new technique to the investigation of the morphology and elemental distribution of a supported catalyst. Using this new tool it was possible to obtain three-dimensional information from regions of the catalyst away from the vicinity of the damaged surface region of the sample. The technique allows the use of both computed tomographic (CT) cross sections as well as the development of a three-dimensional rendering of elements in a material, each of which allows visualization of different areas that would go unnoticed in normal radiographic or CT investigations.

42708 Synthesis and coordination chemistry of 2-(diisopropoxyphosphino)pyridine N,P-dioxide. Crystal and molecular structure of bis[2-diisopropoxyphosphino)pyridine N,P-dioxide]lanthanum nitrate. Conary, G.S. (Univ. of New Mexico, Albuquerque (USA)); Russell, A.A.; Paine, R.T.; Hall, J.H.; Ryan, R.R. *Inorganic Chemistry (USA),* 27(18): 3242-3245 (7 Sep 1988). DOE Contract AS04-82ER40079.

The preparation of 2-(diisopropoxyphosphino)pyridine N,P-dioxide and the results of a study of its coordination chemistry with $La(NO_3)_3$ are reported. Structural studies indicate that 2-(dialkoxyphosphino)pyridine N,P-dioxide should act as good La(III) ion extractants. Future liquid-liquid evaluation of the separation capabilities of the ligands. 15 references, 1 figures, 3 tables.

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Refer also to citation(s) 41542, 41554, 41854, 41855, 42292, 42481, 42525, 42534, 42537, 42621, 42699, 42789, 42790, 42799, 42800, 42860, 42875, 43489, 43553, 44324

42709 (AECL–9073) **Solubility and stability of inorganic carbonates. An approach to the selection of a waste form for carbon-14.** Taylor, P. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 59p. Order Number DE89634755/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

The chemistry of inorganic carbonates is reviewed, with emphasis on solubility and hydrolytic stability, in order to identify candidate waste forms for immobilization and disposal of ^{14}C. At present, $CaCO_3$ and $BaCO_3$ are the two most widely favoured wasted forms, primarily because they are the products of proven CO_2-scrubbing technology. However, they have relatively high solubilities in non-alkaline solutions, necessitating care in selecting and assessing an appropriate disposal environment. Three compounds with better solubility characteristics in near-neutral waters are identified: bismutite, $(BiO)_2CO_3$; hydrocerussite, $Pb_3(OH)_2(CO_3)_2$; and rhodochrosite, $MnCO_3$. Some of the limitations of each of these alternative waste forms are discussed.

42710 (ANL/APS-TM–3, pp. 25-43) **Synchrotron x-ray scattering studies of earth materials.** Waychunas, G.A.; Brown, G.E. Jr.; Finger, L.W. Argonne National Lab., IL (USA). Apr 1988. (CONF-880194–: Workshop on synchrotron X-ray sources and new opportunities in the earth sciences, 18-20 Jan 1988). In *Synchrotron x-ray sources and new opportunities in the earth sciences: Workshop report.* Order Number DE88009858/JAW. Available from NTIS, PC A07/MF A01.

During the past decade, the increased availability of synchrotron x-ray sources combined with new analysis techniques have revolutionized x-ray scattering methods. These methods provide the primary means for structural characterization of materials of all types. For example, powder diffraction techniques are no longer restricted to phase identification and unit cell definition, but now can be used to refine the crystal structure of a powdered phase using the full pattern-fitting method devised by Rietveld. In addition, intensity information obtained from powder diffraction experiments can be used to solve crystal structures with Patterson techniques or direct methods of structure solution. The use of synchrotron radiation in powder diffraction experiments had led to dramatic improvements in resolution, peak shapes, and time required for data collection, making such structure solution work on powder samples feasible. An example of the improved resolution possible with synchrotron-based diffraction on a powdered mixture of the minerals quartz (SiO_2), orthoclase ($KAlSi_3O_8$), and albite ($NaAlSi_3O_8$) is reviewed. Although it is possible to identify phases in the laboratory-derived pattern, it is not possible to extract separate peak integrated intensities for Rietveld analysis. The synchrotron-derived pattern overcomes this difficulty.

42711 (DOE/DP/10554–1, pp. 19, Paper 1) **Relative ion expansion velocity in laser-produced plasmas.** Goldsmith, S.; Moreno, J.C.; Griem, H.R.; Cohen, L.; Richardson, M.C. Maryland Univ., College Park, MD (USA). Lab. for Plasma and Fusion Energy Studies. Dec 1987. In *Thermal transport studies using extreme ultraviolet spectroscopy: Final technical report, 5 March 1986-30 June 1987.* Order Number DE89001854/JAW. Available from NTIS, PC A04/MF A01.

The spectra of highly ionized titanium, Ti XIII through Ti XXI, and C VI Lyman lines were excited in laser-produced plasmas. The plasma was produced by uniformly irradiating spherical glass microballoons coated with thin layers of titanium and parylene. The 24 beam Omega laser system produced short, 0.6 ns, and high intensity, 4 x 10^{14} W/cm^2, laser pulses at a wavelength of 351 nm. The measured wavelength for the 2p-3s Ti XIII resonance lines had an average shift of +.023 Å relative to the C VI and Ti XX spectral lines. No shift was found between the C VI and the Ti XIX through Ti XXI lines. The shift is attributed to a Doppler effect, resulting from a difference of 2.6 x 10^7 cm/s in the expansion velocities of Ti XX and Ti XIII ions. Assuming a coronal ionization equilibrium and a radiative-collisional model to estimate ion level population, it is shown that Ti XIII and Ti XX lines are excited in plasmas differing significantly in electron temperature.

42712 (DOE/DP/10554–1, pp. 14, Paper 2) **Identification of new Ti XXI and Ti XIX transitions emitted by laser-produced plasmas.** Moreno, J.C.; Goldsmith, S.; Griem, H.R.; Cohen L.; Richardson, M.C. Maryland Univ., College Park, MD (USA). Lab. for Plasma and Fusion Energy Studies. Dec 1987. In *Thermal transport studies using extreme ultraviolet spectroscopy: Final technical report, 5 March 1986-30 June 1987.* Order Number DE89001854/JAW. Available from NTIS, PC A04/MF A01.

New spectral emission lines of Ti XXI and Ti XIX have been observed and classified from a laser-produced plasma. The wavelength region for these lines is from 12 to 15 Å.

42713 (DOE/ER/13463–6) **Novel macrocyclic carriers for protron-coupled liquid membrane transport: Progress report, December 1, 1988–November 30, 1989.** Lamb, J.D.; Bradshaw, J.S.; Izatt, R.M. Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry. Jul 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER13463. Order Number DE89016465/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This progress report describes work accomplished in our project during the past 12 months. The research is divided into two principal parts: synthesis of macrocyclic compounds, and liquid membrane experiments.

42714 (DOE/ER/13950–1) **Studies of ion dissociation: Structure and heats of formation of ions, molecules, and free radicals: Progress report, August 1988–April 1989.** Baer, T.

North Carolina Univ., Chapel Hill, NC (USA). Dept. of Chemistry. 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER13950. Order Number DE89015964/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Research on dissociation of ions continued. This quarter, a photoelectron photoion coincidence apparatus was constructed. It was designed to allow for sample heating in the high pressure expansion chamber in order to generate free radicals by pyrolysis. Also, the reaction of HCl loss from ethylchloride ions has been studied. (CBS)

42715 (EMR/ER–87-45(TR)) **Surface chemistry and reduction behaviour of γ-alumina supported molybdenum oxide.** Brown, J.R. Canada Centre for Mineral and Energy Technology, Ottawa, ON (Canada). Energy Research Labs. 1987. 26p. (MICROLOG–87-06441). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

Alumina supported molybdenum oxide, which is usually impregnated with a promoter such as cobalt oxide, is the principal catalyst used for hydrotreating crude oil. Its unique performance may be better understood by directly measuring the surface region of the precursor oxide state prior to and following the ecatalyst's exposure to hydrogen gas at elevated temperatures. An impregnated MoO_3/alumina catalyst (20 wt % MoO_3) and unsupported reference materials (Mo metal, MoO_2 and MoO_3) were examined after H_2-titration by X-ray photoelectron spectroscopy (XPS). Reduction tests and subsequent XPS analyses were conducted with the utmost care to prevent air exposure hence the uncertainty about the reoxidation of Mo species. To achieve this an elaborate reaction testing and inert transfer facility was designed and constructed. It is concluded that: Mo on the exterior of the catalyst is not detectable in oxidation states below Mo^{4+} after hydrogen treatment (798 K, 20 h); the Mo/Al atomic ratio was unaltered after reduction suggesting sintering and/or diffusion processes are not significant; and sorbed moisture may be critical in reducing Mo^{6+} completely to the metallic state. Reduction tests performed on reference metals confirmed the integrity of the specimen transfer vessel and the transfer methodology. 13 refs 5 figs 5 tabs

42716 (INFO–0180-2) **Investigation of the explosion hazards of hydrogen sulphide. Phase II.** Moen, I.O. Atomic Energy Control Board, Ottawa, ON (Canada). Jan 1986. 90p. Order Number DE89634756/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The results of Phase II of an investigation directed towards quantifying the explosive hazards of hydrogen sulphide in air are described. This second and final phase is focussed on flame acceleration until detonation in obstacle environments simulating a heavy water plant. The results of previous experimental tests, both small and large scale, are compiled and summarized and the results of a series of flame acceleration tests are reported. These tests were performed in order to assess the potential for damaging explosions in simulated industrial environments with repeated obstacles. The experimented apparatus consisted of a channel 1.8 m x 1.8 m in cross-section and 15.5 m long. Two obstacle configurations were tested, corresponding to 500 mm or 220 mm diameter tubes mounted across the channel at regular intervals. Tests were performed with acetylene, propane and hydrogen sulphide fuels. The results of numerical simulation are also reported and compared with the observed results. Scaling predictions are also made. The key results are summarized in the main text, and detailed reports covering the various aspects are included in three annexes.

42717 (INFO–0180-2A) **Investigation of the explosion hazards of hydrogen sulphide. (Phase II). Appendices.** Moen, I.O. Atomic Energy Control Board, Ottawa, ON (Canada). Jan 1986. 172p. Order Number DE89634757/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The results of Phase II of an investigation directed towards quantifying the explosive hazards of hydrogen sulphide in air are described. This second and final phase is focussed on flame acceleration until detonation in obstacle environments simulating a heavy water plant. The results of previous experimental tests, both small and large scale, are compiled and summarized and the results of a series of flame acceleration tests are reported. These tests were performed in order to assess the potential for damaging explosions in simulated industrial environments with repeated obstacles. The experimented apparatus consisted of a channel 1.8 m x 1.8 m in cross-section and 15.5 m long. Two obstacle configurations were tested, corresponding to 500 mm or 220 mm diameter tubes mounted across the channel at regular intervals. Tests were performed with acetylene, propane and hydrogen sulphide fuels. The results of numerical simulation are also reported and compared with the observed results. Scaling predictions are also made. The key results are summarized in the main text, and detailed reports covering the various aspects are included in three annexes.

42718 (INIS-SU–89, pp. 6) **Preparation and physicochemical study of double germanium triphosphates $GeMP_3O_{10}$, where M=Li, Na.** Lyutsko, V.A. (Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR)); Vrublevskij, A.V. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

Short Communication

42719 (INIS-SU–89, pp. 114-115) **Purification of rare alkali element chloride melt using phosphate adsorbents.** Kryukova, A.I. (Gor'kovskij Gosudarstvennyj Univ., Gorki (USSR)); Kharlamova, A.A.; Skiba, O.V.; Korshunov, I.A. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

Short Communication

42720 (INIS-SU–89, pp. 161-162) **Kinetics of cation impurity redistribution during formation of hexagonal monocrystal lithium iodate.** Vasil'eva, L.V. (Moskovskij Inst. Stali i Splavov, Moscow (USSR)); Kozlova, N.S.; Morozov, V.I.; Portnov, O.G.; Rozin, K.M. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

Short Communication

42721 (INIS-SU–97, pp. 195-198) **Coordination chemistry of di(2-ethylhexyl)phosphoric acid salts in extraction processes.** Stoyanov, Ye.S. (Moskovskij Inst. Tonkoj Khimicheskoj Tekhnologii, Moscow (USSR)); Mjkhailov, V.A. AN SSSR, Moscow (USSR). 1988. (CONF-8807136–: ISEC '88: international solvent extraction conference, Moscow (USSR), 18-24 Jul 1988). In *International solvent extraction conference. Vol. 1. Conference papers.* Order Number DE89012151/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Methods of NMR ^{31}P, IR and electron spectroscopy were used to study chemical composition, molecular structure and the character of hydration of neutral and acid salts, formed in organic phase during solvent extraction of alkali, alkaline earth and some transition metals (M=V, Zr, Hf and others) by di-2-ethylhexyl phosphoric acid (HX). It is shown that neutral and some acid salts formed by HX in nonaqueous solutions and in the presence of water tend to polymerize with formation of associates of a complex structure. Acid salts of $MX_2(HX_2)_2$ composition (M=Zr, Hf) extract HNO_3, Fe^{3+}, Eu^{3+} and Sc^{3+} from nitric acid solutions much better, than HX itself. 5 refs.

42722 (INIS-SU–97, pp. 226-228) **Direct evidence of synergistic extraction effect-studies on synergistic extraction of neodymium with HPMTFP and Ph_3PO.** Chun-Hui Huang (Beijing Univ., BJ (China)); An-Phing Deng; Chun-Hua Yan; Guang-Xian Xi. AN SSSR, Moscow (USSR). 1988. (CONF-8807136–: ISEC '88: international solvent extraction conference, Moscow (USSR), 18-24 Jul 1988). In *International solvent extraction conference. Vol. 1. Conference papers.* Order Number DE89012151/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

A study was made on extraction of neodymium by 1-phenyl-3-methyl-4-trifluoroacetyl-pyrazolone (HPMTFP) and triphenyl oxide

(TPO). It is shown that substitution of two hydrophobic TPO molecules for two water molecules in extracted complex leads to synergetic extraction effect. Crystal and molecular structures of extracted complexes were determined. Crystals Nd(PMTFP)$_3$center dot2H_2O are monoclinic, sp.gr. $P2_1c/$, a=17.799, b=12.661, c=18.691 A, β=102.71, ν=4108.8 A. The central Nd atom is coordinated with 8 O-atoms, 6 of them are from $PMTFP^-$ groups and 2-from water molecules. Crystals Nd(PMTFP)$_3$x2TPO are triclinic, sp.gr. P-bar1, a=12.880, b=13.649, c=21.670A, d=93.14, β=91.63, γ=115.99 deg, ν=3413.6 A^3. Nd atom is coordinated with 8 O-atoms. In both complexes O-atoms are located in verteces of a square antiprism around Nd atom. 3 refs.; 3 figs,; 2 tabs.

42723 (INIS-SU–97, pp. 310-311) **Noble metal extraction with novel polyfunctional reagents.** Afsaletdinova, N.G. (AN SSSR, Ufa (USSR). Inst. Khimii); Khisamutdinov, R.A.; Murinov, Yu.I. AN SSSR, Moscow (USSR). 1988. (CONF-8807136–: ISEC '88: international solvent extraction conference, Moscow (USSR), 18-24 Jul 1988). In *International solvent extraction conference. Vol. 1. Conference papers.* Order Number DE89012151/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Solvent extraction and complexing of rhodium (3) and ruthenium (3) with aminosulfides and aminoketosulfides have beenstudied. Ruthenium (3) and rhodium (3) solvent extraction from strong acid media proceeds according to the mechanism of interphase anion exchange with formation of ion associates, and from weak acid ones-according to complicated mechanism. Correlation of rhodium (3) and ruthenium (3) extraction by amino-sulfides and amonoketosulfides with extraction of other noble metals enables to conclude, that kinetic factor and acidity of aqueous phase are of particular importance.

42724 (INIS-SU–97, pp. 341-344) **Extraction properties and design of a new class of extractants: the hydroxydiphosphonic acids.** Kanaan, M. (Paris-13 Univ., 93 - Saint-Denis (France)); Leroux, Y.; Marliere, F.; Wozniak, M.; Pareau, D. AN SSSR, Moscow (USSR). 1988. (CONF-8807136–: ISEC '88: international solvent extraction conference, Moscow (USSR), 18-24 Jul 1988). In *International solvent extraction conference. Vol. 1. Conference papers.* Order Number DE89012151/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Synthesis of one of representatives of hydroxydiphosphonic acids $C_{17}H_{35}C(OH)(PO_3H_2)_2$ (OHDP) is described; extraction of uranium (4), dysprosium (3) and europium (3) by this extractant from aqueous solutions of perchloric acid is investigated. Low solubility of the extractant and complexes on its basis in organic solvents can be refferred to its drawbacks. At any acidity of the aqueous phase uranium (4) is extracted completely if extractant is sufficiently concentrated. Extraction of dysprosium (3) and europium (3) decreases as acidity grows. It is noted that in the case of uranium (4) OHDP is able to exchange 2 protons in molecule, and in the case of Dy^{+3} and Eu^{+3} only one proton is substituted in each OHDP molecule. 11 refs.; 2 figs.

42725 (INIS-SU–101) **Thermodynamics and thermochemistry of solutions. Proceedings of the institute. Issue 148.** Moskovskij Khimiko-Tekhnologicheskij Inst., Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). 1987. 117p. (In Russian). Order Number DE89012194/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; INIS.

Individual papes are processed separately. (DLC)

42726 (INIS-SU–101, pp. 3-12) **Regularities of thermochemical characteristics of 1-1, 2-1, 3-1 electrolyte solutions in dimethyl sulfoxide-water and propylene carbonate water mixtures.** Vorob'ev, A.F.; Monaenkova, A.S.; AlekseeV, G.I. Moskovskij Khimiko-Tekhnologicheskij Inst., Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). 1987. (In Russian). In *Thermodynamics and thermochemistry of solutions. Proceedings of the institute. Issue 148.* Order Number DE89012194/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; INIS.

In an air-tight tilting calorimeter with an isothermal casing enthalpies of praseodymium chloride solution in water, dimethyl sulfoxide (DMSO) - water mixtures, contaning 3.86 and 18.53 mol.% DMSO, and propylene carbonate (PC) - water mixtures, containing 1.85 and 3.23 mol.% PC are measured. The enthalpies of praseodymium chloride solution in the given mixtures in case of infinite solution dilution are determined. Solvation enthalpies of praseodymium and neodymium chlorides, as well as alkali earth metal and magnesium chlorides in water and DMSO - water and PC - water mixtures are calculated. Regularities in thermochemical characteristics of solutions of the given salts in DMSO - water and PC - water mixtures are discussed.

42727 (INIS-SU–101, pp. 16-22) **Isopiestic study of quaternary mutual aqueous-salt systems formed from alkali metal sulfates and chlorides or nitrates.** Frolov, Yu.G.; Nasonova, G.I.; Shmel'kova, O.I.; Martynova, N.I. Moskovskij Khimiko-Tekhnologicheskij Inst., Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). 1987. (In Russian). In *Thermodynamics and thermochemistry of solutions. Proceedings of the institute. Issue 148.* Order Number DE89012194/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; INIS.

A relation for calculating osmotic coefficients of quaternary mutual aqueous-salt systems containing different-valent ions taking into account stoichiometric coefficients of ion exchange reaction is determined. Deviations of the experimental data on inverse total concentration and osmotic coefficients from the calculated ones are determined and the effect of anion and cation nature on these deviations is shown. The ion exchange equilibrium shift in the studied systems is estimated and its direction is determined.

42728 (INIS-SU–101, pp. 22-27) **Investigation of molybdenum-molybdenum oxide electrode in water and in aqueous-ethanolic media.** Khomutov, N.E.; Peretrukhin, O.V. Moskovskij Khimiko-Tekhnologicheskij Inst., Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). 1987. (In Russian). In *Thermodynamics and thermochemistry of solutions. Proceedings of the institute. Issue 148.* Order Number DE89012194/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; INIS.

Using the potentiometric method equilibrium of the Mo-MoO_2-MoO_3 system being in contact with deaerated and air-saturated aqueous and aqueous-ethanolic electrolyte solutions in the pH range from 0 to 10.5 is studied. It is shown that equilibrium potentials of these systems vary with pH according to the thermodynamical Nernst equation for $MoO_2+H_2OMoO_3+2H^2+2e$ reaction in the pH range from 0 to 4.5 in deaerated and from 0 to 2.5 in air-saturated solutions. The potential dependence on the logarithm of water molar fraction in aqueous-ehtanolic solutions is linear.

42729 (INIS-SU–101, pp. 52-57) **Solution enthalpies of alkali metal sulfates in dimethyl sulfoxide-water mixtures.** Nga, D.V.; Solov'ev, S.N.; Vorob'ev, A.F. Moskovskij Khimiko-Tekhnologicheskij Inst., Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). 1987. (In Russian). In *Thermodynamics and thermochemistry of solutions. Proceedings of the institute. Issue 148.* Order Number DE89012194/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; INIS.

In an air-tight calorimeter with an isothermal casing the solution enthalpies of rubidium and cesium sulfates in dimethyl sulfoxide-water mixtures, containing 1.42; 8.99; 18.73; 34.98; 67.48 mol.% dimethyl sulfoxide are measured. The measurements are carried out at 298.15 K and low concentratios of electrolytic solutions. The solution enthalpies of rubidium and cesium sulfates in case of infinite solution dilution are determined. On the basis of the values found by the method of differences in transfer enthalpies the solution enthalpies in studied mixtures of lithium, sodium and potassium sulfates, which are not directly studied in the experiments are determined.

42730 (INIS-SU–104/A, pp. 18) **Possibility of tunnel mechanism of hydrogen sorption on metal oxides at low temperature.** Belousov, V.M. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Fizicheskoj Khimii); Rozhkova, Eh.V. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.

Short note; 1 ref.; 1 tab.

42731 (INIS-SU–104/A, pp. 141) **Cryochemical synthesis of complex zirconium carboxylates.** Shabatin, V.P.; Kozlova, N.N.; Arkhangel'skij, I.V.; Prozorovskaya, Z.N.; Yaroslavtsev, A.B. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.

Short Communication

42732 (INIS-SU–104/A, pp. 113) **Low-temperature reactions of organometallic compounds wih small molecules.** Grinval'd, I.I. (Gor'kovskij Gosudarstvennyj Univ., Gorki (USSR). Nauchno-Issledovatel'skij Inst. Khimii); Lokshin, B.V.; Kshnyakin, G.N. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.

Short Communication

42733 (INIS-SU–104/A, pp. 143-144) **Cryocrystallization processes in yttrium-barium cuprate cryochemical synthesis with the use of nitrates.** Kulakov, A.B.; Tesker, A.M.; Mozhaev, A.P.; Tret'yakov, Yu.D.; Snegirev, V.V. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.

Short note; 3 refs.; 1 tab.

42734 (INIS-SU–104/A, pp. 152) **Photolysis of polyhalogenomethanes in polymers at low temperature.** Kolninov, O.V. (Nauchno-Issledovatel'skij Fiziko-Khimicheskij Inst., Moscow (USSR)); Kolesnikova, V.V.; Krasavina, T.A. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.

Short Communication

42735 (INIS-SU–104/A, pp. 159) **Cryochemical synthesis and study of catalysts.** Akhmedov, V.M. (Azerbajdzhanskij Gosudarstvennyj Univ., Baku (USSR)). Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.

TRANSITION ELEMENT COMPLEXES/catalysts; TRANSITION ELEMENT COMPLEXES/chemical preparation; ALKENES; CHEMICAL COMPOSITION; DIENES; LOW TEMPERATURE; CATALYSTS

42736 (INIS-SU–104/A, pp. 162-163) **Effect of cryochemical synthesis conditions on catalytical activity of samarium cocondensates with hydrocarbons.** Sergeev, G.B.; Komarov, V.S.; Tarkhanova, I.G. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.

Short Communication

42737 (INIS-SU–104/A, pp. 219) **Preparation and properties of samarium fluoroalcoholates.** Klimov, V.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii); Mamchenko, A.V.; Nabiev, Sh.Sh. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.

Short Communication

42738 (INIS-SU–104/A, pp. 220-222) **Kinetics and mechanism of samarium interaction with aliphatic alcohols in low-temperature cocondensates.** Sergeev, G.B.; Zagorskij, V.V.; Grishechkina, M.V. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.

Short note; 1 ref.; 1 tab.

42739 (LBL–26537) **Reaction of oxygen with allene.** Huang, Sheng-yu. Lawrence Berkeley Lab., CA (USA). Jul 1988. 231p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89015219/JAW. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

Elastic scattering studies carried out independently of the work related to the title forms the first section of the dissertation. The low-energy elastic scattering of He with Ar, Kr, Xe has been studied by molecular beam techniques. Two potential forms, exponential-spline-Morse-Morse-spline-van de Waals (ESMMSV) and Simon-Parr-Finlan-Dunham (SPFD), have been used to fit the measured differential cross section. Elastic scattering theory and experimental details are introduced. The reactive scattering of $O(^3P)$ with allene has been studied using crossed molecular beams. Differing from the well known central-carbon-attack (CCA) mechanism in which the final products, carbon monoxide and ethylene, are obtained via a ring intermediate, a new mechanism, terminal-carbon-attack (TCA), has been observed. The production of $O(^3P)$ atoms by radio frequency discharge is also introduced. To assist understanding of the experiments a multi-configuration self-consistent field (MCSCF) study of the reaction of $O(^3P)$ with allene has been carried out. The key feature of the oxygen-allene potential energy surface for both CCA and TCA channels has been calculated with single-zeta (SZ), double-zeta (DZ), and double-zeta plus polarization (DZP) basis sets. Finally, an algorithm for optimizing the trial wavefunction in quantum Monte Carlo calculations has been developed. With the application of group theory, a symmetry-constrained optimization process can yield an improved trial wavefunction for the calculation of excited electronic state energies as well as the ground-state energy. Several applications are discussed. 145 refs.

42740 (LBL–27150) **Pd and Ni thin-film reactions with InP: Possibilities for metal contacts.** Caron, R.P. Lawrence Berkeley Lab., CA (USA). Apr 1989. 91p. Sponsored by DOD;DOE/ER. DOE Contract AC03-76SF00098. Order Number DE89015337/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

An effort has been made to identify metals whose interactions with InP result in phases with thermal stability, uniform morphology, and good reproducibility. Such metals can be useful as components for ohmic contacts to InP and would be superior to standard Au-Ge contacts, which are known to have very rough morphologies with deep protrusions into the underlying semiconductor. Palladium and nickel were chosen for this study because of good results previously reported for these metals with GaAs. 99 refs.

42741 (RCM–02188) **Characterization of reference and site specific humic acids. Contribution to the interlaboratory comparison exercise of the 'COCO-Club' in the CEC project MIRAGE II, Pt. 1: Characterization.** Kim, J.I.; Buckau, G. Technische

Univ. Muenchen, Garching (Germany, F.R.). Inst. fuer Radiochemie. Nov 1988. 56p. Contract FI 1W-0067-D(B). Order Number DE89795972/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

As a contribution to the interlaboratory exercise for the complexation of humic acid and colloid generation (COCO-Club activities) in the CEC project MIRAGE-II, the characterization of selected humic acids have been carried out at TU Muenchen, regarding their elemental compositions, inorganic impurities, spectroscopic properties, size distributions and proton exchange capacities. The commercial humic acid (Na salt) from Aldrich Co. is purified to a protonated form and used as reference material. Furthermore two humic acids extracted from groundwaters from Gorleben (FRG) and Boom Clay (B) are purified to protonated forms and taken as site specific materials. These three humic acids, together with the original Na salt from Aldrich Co., are included in the present characterization exercise. The results of characterization provide basic knowledge supporting the forthcoming study of complexation of actinides and fission products with humic acid and their migration processes in the geosphere. (orig.).

42742 (SAND–89-0287C) **Analysis of surface modified colloidal silicas.** Badley, R.D.; Ford, W.T.; McEnroe, F.J.; Assink, R.A. Sandia National Labs., Albuquerque, NM (USA). 1989. 9p. Sponsored by U.S. Department of Defense. DOE Contract AC04-76DP00789. (CONF-8906187–1: Surface modified oxide conference, 29 Jun 1989). Order Number DE89015849/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Colloidal silica was prepared by hydrolysis of tetraethyl orthosilicate in water, ammonia, and ethanol, and its surface was modified with mercaptopropyl, aminopropyl, and octadecyl groups. The parent and modified silicas were analyzed by ^{13}C and ^{29}Si NMR, elemental analysis, and thermogravimetric analysis (TGA). CP-MAS ^{13}C NMR failed to detect most of the mobile carbons, but direct polarization MAS NMR gave quantitative carbon analyses which agreed with elemental analyses. Direct polarization MAS ^{29}Si NMR showed that esterification of colloidal silica with octadecanol at 190°C did not cause additional crosslinking in the silica. But reaction with octadecyltrimethoxysilane did give a slight increase in siloxane linkages due to the surface reaction. TGA results show that the octadecylsiloxane linkage is thermally more stable than the octadecyloxysiloxane linkage. 5 refs., 3 figs., 3 tabs.

42743 Pressure dependence of the electronic spectra of quasi-one-dimensional Pt_2X semiconductors. Stroud, M.A. (Los Alamos National Lab., NM (USA)); Drickamer, H.G.; Zietlow, M.H.; Gray, H.B.; Swanson, B.I. *Journal of the American Chemical Society (USA)*, 111(1): 66-72 (4 Jan 1989). DOE Contract AC02-76ER01198.

The effects of high static pressure on the electronic absorption spectra of the mixed-valence semiconductors, $K_4[Pt_2(P_2O_5H_2)_4X]\cdot 3H_2O$ (X = Cl, Br), have been investigated to 10.0 GPa. Their electronic spectra exhibit bands attributable to the reduced complex, $[Bu_4N]_4[Pt_2(P_2O_5H_2)_4]$ ($d_{xz},d_{yz} \rightarrow p\sigma$, $d\sigma^* \rightarrow d_{x^2-y^2}$, and $d\sigma^* \rightarrow p\sigma$), and the oxidized complex, $K_4[Pt_2(P_2O_5H_2)_4X_2]\cdot 2H_2O$ ($d_{xz}, d_{yz} \rightarrow d\sigma^*$ and $\sigma(X) \rightarrow d\sigma^*$), along with an intervalence charge-transfer (IVCT) band characteristic of a mixed-valence solid. The reduced (Pt_2) and oxidized (Pt_2X_2) complexes have also been studied so that direct comparisons with the monohalides (Pt_2X) could be made. The $\sigma X \rightarrow d\sigma^*$ transition (observed at 34,500, 32,800, and 35,400 cm^{-1} for Pt_2Cl_2, Pt_2Br, and Pt_2Cl, respectively) exhibits linear blue shifts of ca. 300 cm^{-1}/GPa for each complex. The $d\sigma^* \rightarrow d_{x^2-y^2}$ transition in Pt_2 (35,300 cm^{-1}) shifts red initially and then begins to shift blue above 5.5 GPa, while the $d\sigma^* \rightarrow p\sigma$ band (ca. 27,000 cm^{-1}) exhibits little shift with pressure for Pt_2, Pt_2Cl, and Pt_2Br. The dominant pressure-induced effects that give rise to the above shifts are (i) destabilization of the $d\sigma^*$ and $p\sigma$ levels through increased orbital overlap and d/p mixing and (ii) destabilization of the $d_{x^2-y^2}$ level at high pressure through increased ligand field interactions. 26 references, 14 figures, 1 table.

42744 Volumetric properties of aqueous sodium hydroxide from 273.15 to 348.15 K. Simonson, J.M. (9501896); Ryther, R.J. *Journal of Chemical and Engineering Data (USA)*, 34(1): 57-63 (Jan 1989).

Densities of aqueous sodium hydroxide solutions were measured with a vibrating tube densimeter from 0.06 to 25.2 mol . kg^{-1} at temperatures from 278 to 318 K and pressures from 0.7 to 34.4 MPa. Values of the apparent molar volumes calculated from the measured densities are compared with available literature results at similar experimental conditions. The volumes are correlated as functions of temperature, pressure, and composition with the volumetric form of the ion interaction model to moderately high molalities; an arbitrary power series in $m^{1/2}$ is used at higher molalities. Specific volumes of NaOH(aq) are tabulated at smoothed temperatures, pressures, and molalities. Standard-state partial molar volumes, expansivities, compressibilities, and heat capacities calculated from the treatment are consistent with the reaction thermodynamic properties of water and available values for NaCl(aq) and HCl(aq).

42745 Activation of hydrogen by cationic cyclopentadienyl molybdenum dimers with sulfido ligands. 4. A cationic complex with an allyl thiolate ligand. Weberg, R.T. (Univ. of Colorado, Boulder (USA)); Laurie, J.C.V.; Rakowski Dubois, M. *Journal of Coordination Chemistry (USA)*, 19(1-3): 39-48 (Dec 1988).

A mixture of cis,trans-1-bromo-2-butene was reacted with $(CpMoS)_2S_2CH_2$ ($Cp=C_5H_5$) to form the cationic sulfur-alkylated product $[(CpMo)_2(S_2CH_2)(\mu\text{-}S)(\mu\text{-}SCH_2CH{=}C(H)Me])Br$, (1), which was characterized by spectroscopic methods. The reactivity of the allyl thiolate complex was compared with that of $[(CpMo)_2(S_2CH_2)(\mu\text{-}S)(\mu\text{-}SCMe{=}CHMe)]Br$, (2) an isomer with a vinyl thiolate ligand. Complex 1 does not undergo detectable isomerization in chloroform solution while a complex rearrangement process was observed for 2. The reaction of 1-2 atm of hydrogen with 1 resulted in the formation of 2-bromobutane and a previously characterized molybdenum complex $[CpMoS_2CH_2]_2$. $[(CpMo)_2(S_2CH_2)(\mu\text{-}S)(\mu\text{-}SCHMe(Et))]Br$ was an intermediate in this reaction with hydrogen. It was detected by NMR and synthesized by an independent route. The reaction of methyl lithium with 1 led to the formation of a neutral complex $(CpMo)_2(S_2CH_2)(\mu\text{-}SME)(\mu\text{-}SCH_2CH{=}CHMe)$, (3). Complex 3 reacted under 1-2 atm of hydrogen to form an isomeric mixture of butenes. The nature of the molybdenum products which were isolated from this reaction suggested that homolytic cleavage of the carbon sulfur bond in the allyl thiolate ligand had occurred. Possible reaction pathways for the transformations of 1 and 3 under hydrogen are discussed.

42746 EPR evidence for magnetic exchange through a four-carbon aliphatic bridge in a binuclear copper(II) complex. Single crystal x-ray structure of 7,7'-(1,4-butanediyl)-bis[2,12-dimethyl-3,7,11,17-tetraazabicyclo[11.3.1]heptadeca-1(17),2,11,13,15-p perchlorate monohydrate. Foster, K.A. (Georgia Institute of Technology, Atlanta (USA)); Brown, D.R.; Timken, M.D.; Van Derveer, D.G.; Belford, R.L.; Barefield, E.K. *Journal of Coordination Chemistry (USA)*, 19(1-3): 123-137 (Dec 1988). DOE Contract FG22-84PC70782.

The single crystal x-ray structure of the title, binuclear nickel(II) complex has been determined and the compound used as a host for EPR investigations of the analogous copper(II) complex. The impetus for this work was an earlier suggestion that magnetic exchange interactions detected by EPR spectroscopy on frozen solutions of the biscopper(II) complex were a result of a direct copper-copper interaction in a closed conformation of the binuclear species. Results reported here suggest that the complex exists in the open conformation where the distance between metal centres is maximized and that the magnetic exchange occurs by a super-exchange mechanism through the aliphatic chain. The $|J|$ value for the exchange interaction is greater than 0.018 cm^{-1}. Crystal data for $[Ni_2C_{34}H_{50}N_8](ClO_4)_4 \cdot H_2O$ (298 K): monoclinic, space group $P2_1/n$, a = 13.560(3), b = 11.678(2), c = 15.377(3) Å, β = = 108.48(2)°, ρ_{calcd} = 1.588 g cm^{-3} for Z = 2 and M_r = 1104.1, R = 0.068, R_w = 0.76. The intramolecular Ni-Ni distance is 9.13 Å. The analogous copper complex is isomorphorus with the nickel complex.

42747 Synthesis and crystal structure of a novel mixed valence iron compound, $[(\eta_7^5\text{-cyclopentadienyl})(\eta_7^6\text{-tetralin})Fe(II)]_3[Fe(III)(NCS)_6]$. Coleman, A.W. (Univ. of Alabama,

University (USA)); Baskar, A.J.; Bott, S.G.; Atwood, J.L. *Journal of Coordination Chemistry (USA)*, 17(4): 339-345 (Aug 1988).

The title compound was encountered in the course of preparing $[(\eta^5\text{-}C_5H_5)(\eta^6\text{-}C_{10}H_{12})Fe]SCN$ from $[(\eta^5\text{-}C_5H_5)(\eta^6\text{-}C_{10}H_{12})Fe]PF_6$. The mixed valence iron compound crystallizes in the monoclinic space group $P2_1/c$ with four formula unite per unit cell. There are three crystallographically independent cations and two anions (each residing on a center of inversion) in the asymmetric unit. Lattice constants are a = 17.231(7), b = 18.167(6), c = 16.572(7) Å, and β = 97.86(4)°. 23 references, 1 figure, 4 tables.

42748 Determination of rate constants by the frequency response method. Li, Y.E. (9517341); Willcox, D.; Gonzalez, R.D. *A.I.Ch.E. (American Institute of Chemical Engineers) Journal (New York) (USA)*, 35(3): 423-428 (Mar 1989).

A technique based upon transmission FTIR to obtain rate constants for adsorption and desorption over supported metal catalysts has been developed and tested. The technique requires the use of a sinusoidal perturbation function imposed on steady state linearized adsorption-desorption kinetics. The measurement of a phase lag between the sinusoidal inlet gas phase forcing concentration and the response of surface coverage, together with a measurement of the maximum amplitudes of the forcing function and surface response enable the calculation of the relevant adsorption and desorption rate constants. The technique has been successfully applied to the measurement of both adsorption and desorption rate constants for CO adsorbed on a 1% Pt/SiO_2 catalyst. The values obtained for these rate constants at 343 K were: $K_a = 0.147\ s^{-1}$ and $K_d = 7.28 \times 10^{-3}\ s^{-1}$. A sticking coefficient corresponding to the adsorption of weakly bonded CO on Pt under conditions of high CO surface coverage was obtained.

42749 Isopiestic measurements of the osmotic and activity coefficients for the system $NaClO_4$-$Ba(ClO_4)_2$-H_2O at 25°C. Rush, R.M. (4832000). *Journal of Chemical and Engineering Data (USA)*, 33(4): 477-478 (Oct 1988).

Isopiestic measurements of the osmotic coefficients are presented for the system $NaClO_4$-$Ba(ClO_4)_2$-H_2O. Parameters obtained from these results are used to calculate values of the osmotic and activity coefficients of each component.

42750 High-temperature mutual solubilities for some binary and ternary aqueous mixtures containing aromatic and chlorinated hydrocarbons. Hooper, H.H. (9503321); Prausnitz, J.M.; Michel, S. *Journal of Chemical and Engineering Data (USA)*, 33(4): 502-505 (Oct 1988).

Mutual solubilities at the three-phase equilibrium pressure have been measured for binary mixtures of water with 1,2-dichloroethane and chlorobenzene in the temperature range 75-200°C. Liquid-liquid equilibria were measured for ternary aqueous mixtures containing toluene and phenol at 150 and 200°C and for ternary aqueous mixtures containing thiophene and pyridine at 100 and 150°C. Results are given for equilibrium compositions of both liquid phases and for three-phase equilibrium pressures.

42751 Absolute electronegativity and hardness: application to inorganic chemistry. Pearson, R.G. (Univ. of California, Santa Barbara (USA)). *Inorganic Chemistry (USA)*, 27(4): 734-740 (24 Feb 1988).

The recent concepts of absolute electronegativity, χ, and absolute hardness, η, are briefly reviewed. The operational definitions, $\chi = (I + A)/2$ and $\eta = (I - A)/2$, are used to calculate experimental values for a large number of cations, atoms, radicals, and molecules. The resulting values are shown to be in good agreement with chemical behavior, both as to acid-base character and as to chemical hardness or softness. Anions are modeled by their corresponding radicals, and the importance of local softness, $\tilde{\sigma}$, for delocalized anions is pointed out. Applications of the use of tabulated values of η, both for rank ordering and in numerical calculation, are given. 54 references, 1 figure, 6 tables.

42752 Decreased overall basicity of a series of new N,N'-bis(carboxymethyl) macrocyclic ether-bis(lactone) ligands derived from EDTA and the ring size effect on the stability constants of their lanthanide complexes. Chang, C.A. (Univ. of Texas, El Paso (USA)); Chang, P.H.L.; Qin, S.Y. *Inorganic Chemistry (USA)*, 27(5): 944-946 (9 Mar 1988). DOE Contract FG05-84ER13292.

In order to examine the effects of positions of the nitrogen donor atoms and the relative coordination sites of the two carboxylate groups on lanthanide complexation in the study of the characteristics of both open-chain and macrocyclic ligands for the preparation of novel metal-ion selective reagents, a series of N, N'-bis(carboxymethyl)macrocyclic ether-bis(lactone)ligands derived from ethylenediaminetetraacetic acid have been prepared and characterized. The ligand protonation constants and the lanthanide complex formation constants have been determined and are reported here. 14 references, 2 figures, 2 tables.

42753 Characterization of the organometallic Lewis acid $(\eta^5\text{-}C_5H_5)(CO)Fe(OR_2)(\eta^2\text{-}CH_2 = CHCH_3)^+BF_4^-$. Cutler, A.R. (Rensselaer Polytechnic Institute, Troy, NY (USA)); Todaro, A.B. *Organometallics (USA)*, 7(8): 1782-1787 (Aug 1988).

Protonation of the η^3-allyl complex $Cp(CO)Fe(CH_2CHCH_2)$ (10) with $HBF_4{\cdot}OEt_2$ or $HBF_4{\cdot}OMe_2$ in CH_2Cl_2 (−80°C) affords an extremely reactive organometallic Lewis acid precursor, which degrades above −65°C. The structure assigned to this Lewis acid, on the basis of its ^{11}B and ^{19}F NMR spectral measurements and of its chemical reactivity, is $Cp(CO)Fe(OR_2)(CH_2\text{—}CHCH_3)^+BF_4^-$ (8). Similar NMR measurements are also reported for appropriate model compounds containing coordinated fluoroborate [e.g., $Cp(CO)_2FeFBF_3$ and $Cp(CO)_3MoFBF_3$] or ionic BF_4^- e.g., $Cp(CO)_2Fe(THF)^+FB_4^-$. Some potential ligands (e.g., THF) deprotonate 8 back to starting 10, whereas others (e.g., acetonitrile) readily convert 8 into examples of disubstituted complexes, $Cp(CO)Fe(L_1)(L_2)^+BF_4^-$. Excess $P(OPh)_3$, for example, converts 8 first to the η^2-propene derivative $Cp(CO)Fe(CH_2\text{—}CHCH_3)P(OPh)_3^+BF_4^-$ (13) and then in refluxing CH_2Cl_2 to $Cp(CO)Fe[P(OPh)_3]_2^+BF_4^-$ (14). Reactions between 8 and the acetyl complexes $Cp(CO)(L)FeCOCH_3$ (L = CO, PPh_3) give the bimetallic μ-(η^1-C,O)-acetyl compounds $Cp(CO)(L)Fe\text{-}C(CH_3)O\text{-}Fe(CO)_2Cp^+BF_4^-$ (15) in low yields, with no evidence of forming μ-(η^2-C,O)-acetyl derivatives $Cp(CO)Fe(CH_3CO)Fe(L)Cp^+BF_4^-$. The organometallic etherate complex $Cp(CO)_2Fe(OMe_2)^+BF_4^-$ (2a) results through protonolysis of $Cp(CO)_2FeCH_3$ with $HBF_4{\cdot}OMe_2$ between −30 and −78°C.

42754 Electron-transfer chemistry of $(Me_5C_5)_2Yb$: cleavage of diorganoperoxide and related chalcogenides to give $(Me_5C_5)_2Yb(ER)(L)$ (E = O, S, Se, or Te; L = a Lewis base). Crystal structure of $(Me_5C_5)_2Yb(TePh)(NH_3)$. Berg, D.J. (Lawrence Berkeley Lab., CA (USA)); Andersen, R.A.; Zalkin, A. *Organometallics (USA)*, 7(8): 1858-1863 (Aug 1988). DOE Contract AC03-76SF00098.

The divalent metallocenes of ytterbium $(Me_5C_{52})(OEt_2)$ or $(Me_5C_5)_2Yb(NH_3)_2$ react with molecules of the type REER to give the trivalent ytterbium complexes $(Me_5C_5)_2Yb(ER)(L)$, where L is OEt_2 or NH_3, E is S, Se, or Te, and R is a phenyl or substituted phenyl group. The ammonia complexes are easier to characterize than the diethyl ether complexes since the latter complexes lose ether in the solid state and give unsatisfactory microanalytical data whereas the ammonia complexes give satisfactory elemental analyses. In addition, the line width of the Me_5C_5 protons in the ^1H NMR spectra of the diethyl ether complexes is ca. 500 Hz whereas the line width at half-height is ca. 50 Hz for the ammonia complexes, consistent with the notion that the barrier to chemical exchange is higher for the ammonia complexes. The peroxides ROOR, where R is Me_3C or Me_3Si, give the alkoxides $(Me_5C_5)_2Yb(OR)(NH_3)$, and $Et_2NC(S)SS(S)CNEt_2$ gives the known $(Me_5C_5)_2Yb(S_2CNEt_2)$. In contrast, dialkyl dithiophosphinates give $(Me_5C_5)_2Yb(S_2PR_2)$ and R_2PPR_2, where R is Me or Et. The synthetic routes developed developed in this work are the best methods currently available for synthesis of these trivalent species. The crystal structure of $(Me_5C_5)_2Yb(TePh)(NH_3)$ has been done. The crystals are orthorhombic, $P2_12_12_1$, with a = 11.823 (3) Å, b = 25.917 (6) Å, c = 8.539 (2) Å, and V = 2616.5 Å^3. For Z = 4, the calculated density is 1.69 g cm^{-3}. The Yb-Te distance is 3.039 (1) Å, and the Yb-Te-C(Ph) angle is 113.0 (3)°.

42755 Reactions of Sc^+ with alkenes in the gas phase. Lech, L.M. (Purdue Univ., West Lafayette, IN (USA)); Freiser, B.S.

Organometallics (USA), 7(9): 1948-1957 (Sep 1988). DOE Contract FG02-87ER13766.

Fourier transform mass spectrometry (FTMS) was used to study the exothermic reactions of laser desorbed Sc^+ with various linear, branched, and cyclic olefins. Single and double dehydrogenations were observed to be at the predominant processes in marked contrast to Fe^+ and Co^+ which yield predominantly C-C bond cleavage products. Structures of some of the commonly occurring product ions were probed by collision-induced dissociation and ion-molecule reactions, including H/D exchange. Evidence is presented for two stable isomers of $ScC_4H_6^+$, $ScC_4H_4^+$, and $ScC_5H_6^+$. A modification to the experimental pulse sequence was implemented which made possible the formation and isolation of various endothermic reaction products. In particular Sc^+-H was generated by an endothermic reaction of Sc^+ with ethane and was used to bracket the Sc^+-benzene bond strength at $D°(Sc^+\text{-benzene}) = 53 \pm 5$ kcal/mol.

42756 Solid-state organometallic chemistry of molecular metal oxide clusters: C-H activation by an iridium polyoxometalate. Siedle, A.R. (3M Corporate Research Labs., St. Paul, MN (USA)); Newmark, R.A.; Brown-Wensley, K.A.; Skarjune, R.P.; Haddad, L.C.; Hodgson, K.O.; Roe, A.L. *Organometallics (USA),* 7(9): 2078-2079 (Sep 1988).

Hydrogenation of $[(Ph_3P)_2Ir(C_8H_{12})]_3PW_{12}O_{40}$ in a solid-gas reaction produces $[(Ph_3P)_2IrH_2]_3PW_{12}O_{40}$. EXAFS studies of the molybdenum analogue indicate the presence of isolated, lattice-stabilized $(Ph_3P)_2IrH_2^+$ ions. H—D exchange with $CD_3CH{=}CH_2$ occurs via a reversible C—H addition reaction that also produces $[(Ph_3P)_2IrH(\pi\text{-}C_3H_5)]_3PW_{12}O_{40}$ and scrambles the $C_3D_3H_3$ deuterium label. Exchange with toluene is selective and involves activation of aromatic but not aliphatic C-H bonds. Slow exchange with c-C_6D_{12} also occurs.

42757 Neutral technetium(V) complexes with amide-thiol-thioether chelating ligands. Bryson, N. (Massachusetts Institute of Technology, Cambridge (USA)); Dewan, J.C.; Lister-James, J.; Jones, A.G.; Davison, A. *Inorganic Chemistry (USA),* 27(12): 2154-2161 (15 Jun 1988).

General methods for the preparation of ligands of the type $R'SCH_2CONHCH_2CH_2NHCOCH_2SR$, $H_2ema(R)(R')$, where R = alkyl, aminoalkyl, and carboxyalkyl and R' = H, benzoyl, acetamidomethyl, and benzamidomethyl are described. New methods for the protection and deprotection of thiols with triphenylmethyl and amidomethyl groups have been developed. These ligands have been reacted with $(Bu_4N)[TcOCl_4]$ and $Na[TcO(eg)_2]$ (eg = ethylene glycolato), and for the cases where R = Me, CH_2Ph, $(CH_2)_{10}COOH$, and $CH_2CH_2(NC_4H_8O)$, neutral complexes, [TcO(emaR)], have been isolated and characterized. The complex $[TcO(ema(CH_2CH_2NC_4H_8O))]$ was crystallized as a monohydrate, and a single-crystal X-ray structure determination was performed. For all of the $[TcO(ema(CH_2CH_2NR_2))]$ complexes, an intramolecular dealkylation occurred to cleanly form $[TcO(ema)]^-$, which can be isolated as the $AsPh_4^+$ salt. Furthermore, $[TcO(ema(CH_2Ph))]$ and $[TcO(ema(Me))]$ were reacted with amines, water, and halides to give the dealkylated products. Crystal data for $C_{12}H_{20}N_3O_4S_2Tc{\cdot}H_2O$: monoclinic, a = 12.120 (1) Å, b = 7.172 (1) Å, c = 18.933 (2) Å, β = 94.29 (1)°, V = 1641.1 Å^3, space group = $P2_1/n$ (No. 14), Z = 4, R = 0.042, R_w = 0.055. 34 references, 3 figures, 3 tables.

42758 Efficiency of intersystem crossing to the lowest excited state of chromium polypyridyls determined by using pulsed photoacoustic microcalorimetry. Lynch, D. (Wayne State Univ., Detroit, MI (USA)); Endicott, J.F. *Inorganic Chemistry (USA),* 27(12): 2181-2184 (15 Jun 1988).

A simple photoacoustic detection system for determining intersystem crossing yields, Φ_{isc}, of inorganic systems is described. Values found for Φ_{isc} of $Cr(bpy)_3^{3+}$, $Cr(phen)_3^{3+}$, $Cr(5\text{-}Cl\text{-}phen)_3^{3+}$, and $Cr(4,4'\text{-}Me_2bpy)_3^{3+}$ are 0.93, 0.95, 0.73, and 1.04, respectively. This is in excellent agreement with the reported values of 0.95-1.0 for $Cr(bpy)_3^{3+}$ based on other techniques. This technique has also been used to determine that there are long-lived ($\tau > 10$ ns) upper excited states or other high-energy species produced that prevent rapid relaxation to the $^2E/^2T$ manifold following excitation of $Cr(4,7\text{-}Ph_2phen)_3^{3+}$ and $Cr(4,7\text{-}Me_2phen)_3^{3+}$. Without resorting to deconvolution techniques, this method can be used on systems that have rapid relaxation ($\tau < 1$ ns) of the upper excited states and lifetimes > 5 μs for the lowest energy state when a 5-MHz transducer is used for detection of the photoacoustic signal. 15 references, 7 figures, 1 table.

42759 Facile interconversions of alkyne and vinylidene ligands on divalent molybdenum and tungsten. Nickias, P.N. (Univ. of Kentucky, Lexington (USA)); Selegue, J.P.; Young, B.A. *Organometallics (USA),* 7(10): 2248-2250 (Oct 1988).

Molybdenum alkynyls trans-$[M(C{\equiv}CCMe_3)L\text{-}(PR_3)_2(Cp)]$ are prepared by deprotonation of $[Mo(HC{\equiv}CCMe_3)(PR_3)_2(Cp)]^+$ PR_3 = $P(OMe)_3$; PR_3 = PMe_2Ph using $NaN(SiMe_3)_2$ in the presence of CO or $P(OMe)_3$. Protonation of $[Mo(C{\equiv}CMe_3)(CO)(P(OMe)_3)_2(Cp)]$ at −78°C gives trans-$[Mo(C{=}CHCMe_3)(CO)(P(OMe)_3)_2(Cp)][X]$, which decarbonylates above 0°C (X = BF_4) or is trapped by excess triflic acid (HOTf) to give the alkylidyne complex trans-$[Mo(\equiv CCH_2CMe_3)(OTf)(P(OMe)_3)_2(Cp)]$ [Otf]. Protonation of $[Mo(C{\equiv}CCMe_3)(CO)(PMe_2Ph)_2(Cp)]$ with HOTf gives stable trans-$[Mo(C{=}CHCMe_3(CO))(PMe_2Ph)_2(Cp)][OTf]$, while exposure of $[Mo(HC{\equiv}CCMe_3)(PMe_2Ph)_2(Cp)][BF_4]$ to 1 atm of CO effects is conversion to trans-$[Mo(C{=}CHCMe_3)(CO)(PMe_2PH)_2(Cp)][BF_4]$. The structure of trans-$[W(C{=}CMePh)(CO)(P(OMe)_3)_2(Cp)][PF_6]$ was determined by X-ray diffraction (R = 3.3%, R_w = 4.0%).

42760 Studies on the bonding of polynuclear heteroaromatic nitrogen ligands to (pentamethylcyclopentadienyl)rhodium dication: the role of nitrogen versus π-complexation on the regioselective hydrogenation of the nitrogen ring. Fish, R.H. (Lawrence Berkeley Lab., CA (USA)); Kim, H.S.; Babin, J.E.; Adams, R.D. *Organometallics (USA),* 7(10): 2250-2252 (Oct 1988). DOE Contract AC03-76SF00098.

The reactions of quinoline (1), isoquinoline (2), 1,2,3,4-tetrahydroquinoline (3), and 2-methylquinoline (4) with (pentamethylcyclopentadienyl)rhodium dication $[Cp^*Rh(acetone)_3^{2+}$, $Cp^*Rh(acetonitrile)_3^{2+}$, or $Cr^*Rh(p\text{-}xylene)^{2+}X_2$; X = PF_6 or $BF_4]$ were studied to ascertain nitrogen (N) versus π-bonding. Ligands 1 and 2 were found to form N-bonded rhodium complexes, while ligand 3 preferred π-coordination (η^6). Ligand 4 was found to provide both π- and N-bonded complexes. A single-crystal X-ray structural analysis of a derivative of $Cp^*Rh(quinoline)(acetonitrile)_2^{2+}$, $[Cp^*Rh(quinoline)(\mu\text{-}hydroxo)]_2^{2+}$ synthetic precursors were excellent catalysts or catalyst precursors for the selective hydrogenation of 1, 2, and 4 to their corresponding tetrahydro derivatives. This latter result defines the important role of N-bonding for regioselective nitrogen ring reduction.

42761 Synthesis, spectroscopy, and photophysical behavior of mixed-ligand mono- and bis(polypyridyl)chromium(III) complexes. Examples of efficient, thermally activated excited-state relaxation without back intersystem crossing. Ryu, C.K. (Wayne State Univ., Detroit, MI (USA)); Endicott, J.F. *Inorganic Chemistry (USA),* 27(13): 2203-2214 (29 Jun 1988).

A series of $Cr^{III}(PP)_xX_{6-2n}$ complexes have been prepared and characterized in which n = 1 or 2, PP = 2,2'-bipyridine or 1,10-phenanthroline, and X = NH_3, en/2, acac$^-$/2, CN^-, or NCS^-. The $(^2E)Cr^{III}(PP)_nX_{6-2n}$ excited states are much weaker oxidants than their $(^2E)Cr(PP)_3^{3+}$ parents. The visible spectroscopy of the $Cr^{III}(PP)_nX_{6-2n}$ complexes is complicated by overlapping absorptions. A very prominent feature of these absorptions is a regular, relatively narrow band progression with energies independent of X. This progression is attributed to direct excitation into the triplet-π^* ligand manifold states, with the forbidden singlet-triplet transitions of the free polypyridyl ligand(s) being relaxed by spin-spin coupling in the Cr(III) complexes. The $(^2E)Cr(III)$ lifetimes, $\tau(^2E)$, of these complexes in fluid and glass solutions are strongly temperature dependent but approach a limiting value at low temperatures: $[\tau(^2E)]^{-1} = k_r + k_{nr}^0 + A\exp(-E_a/RT)$, where k_r and k_{nr}^0 are the nearly temperature-independent radiative and nonradiative relaxation rate constants, respectively. The room-temperature lifetimes of the mixed-ligand complexes vary over a 30-fold range, and $\tau(^2E)$ is much smaller for these complexes than found for their $Cr(phen)_3^{3+}$ and $Cr(bpy)_3^{3+}$ parents. The range of lifetimes is not strongly temperature dependent since $E_a = 33 \pm 2$ kJ mol^{-1} and $A = (3.5 \pm 1.1) \times 10^{11}$ s^{-1} for the $Cr^{III}(PP)_nX_{6-2n}$ complexes (X ne CN^-); for X = CN^-, $A \approx 7 \times 10^{12}$ s^{-1}. 65 references, 8 figures, 9 tables.

42762 Raman spectroscopic evidence for side-on binding of peroxide ion to Fe^{III}(edta). Ahmad, S. (Oregon Graduate Center, Beaverton (USA)); McCallum, J.D.; Shiemke, A.K.; Appelman, E.H.; Loehr, T.M.; Sanders-Loehr, J. *Inorganic Chemistry (USA),* 27(13): 2230-2233 (29 Jun 1988).

Resonance Raman spectra of the complex of Fe^{III}-ethylenediaminetetraacetate with hydrogen peroxide have been obtained in the region of the peroxidic O-O stretching vibration that occurs at 815 cm^{-1} in frozen solution. When the complex was prepared from nearly neat, mixed-isotope hydrogen peroxide, $H_2{}^{16}O^{18}O$, a single O-O vibration was observed at 794 cm^{-1}. This observation establishes that the two oxygen atoms of the bound peroxide are equivalent and that the peroxide is ligated in an η^2 side-on configuration in this mononuclear complex. The absence of any shift in ν(O-O) when the complex was prepared in D_2O solvent provides further support for the side-on Fe(O-O) geometry and rules out the alternative η^1 end-on Fe-OOH configuration. In contrast, ν(O-O) of free hydrogen peroxide in the frozen state occurs at 877 cm^{-1} in H_2O and 879 cm^{-1} in D_2O. The 2-cm^{-1} upshift in D_2O is similar to that observed previously with oxyhemerythrin and appears to be characteristic of a hydrogen-bonded or protonated peroxide species. 37 references, 4 figures, 1 table.

42763 Variable photon energy photoelectron spectroscopic studies of covalent bonding in $3d^{10}$ transition-metal compounds. Didziulis, S.V. (Stanford Univ., CA (USA)); Cohen, S.L.; Butcher, K.D.; Solomon, E.I. *Inorganic Chemistry (USA),* 27(13): 2238-2250 (29 Jun 1988).

Variable photon energy photoelectron spectroscopy (PES) is used to determine the valence band electronic structure and to study the covalent bonding properties of three tetrahedral, $3d^{10}$ transition-metal complexes with σ-donor, π-donor ligands: ZnO, $ZnCl_4{}^{2-}$, and CuCl. PES data obtained over the photon energy range of 16.7-1486.6 eV show dramatic intensity changes of valence band features that are caused by changes in photoionization cross sections and resonance effects at the metal 3p absorption edge. Intensity changes with photon energy allow detailed assignments of spectra to be made by using molecular orbital theory. Analyses of the peak intensities and binding energies provide a measure of the covalent bonding. Larger ZnO 3d band splitting relative to that for $ZnCl_4{}^{2-}$ indicates greater ligand field strength (10Dq) for the oxide ligands, which arises from the stronger σ-bonding interactions of the Zn^{2+} 3d with the O^{2-}-2p orbitals. The increased effective nuclear charge on Zn^{2+} shifts the d levels below the ligand levels, making them bonding and reversing the sign of the tetrahedral 10Dq value. This greater effective nuclear charge on Zn^{2+} also significantly lowers the energy of the empty metal 4s and 4p levels, resulting in greater covalent stabilization of the ligand bonding levels in $ZnCl_4{}^{2-}$ than in CuCl. The relative contributions of ionic and covalent bonding in $ZnCl_2$ and CuCl are examined and related to the much greater thermodynamic stability of Zn^{2+} complexes with donor ligands. 74 references, 13 figures, 5 tables.

42764 Electronic and molecular structure of $OTeF_5{}^-$. Miller, P.K. (Colorado State Univ., Fort Collins (USA)); Abney, K.D.; Rappe, A.K.; Anderson, O.P.; Strauss, S.H. *Inorganic Chemistry (USA),* 27(13): 2255-2261 (29 Jun 1988).

Salts of the $OTeF_5{}^-$ anion were investigated by ir and Raman spectroscopy and by x-ray crystallography. Experimental results were compared with ab initio Hartree-Fock calculations on the $OTeF_5$ radical, $Na^+OTeF_5{}^-$, and the singlet and triplet states of the free $OTeF_5{}^-$. The compound $[(PS)H^+][OTeF_5{}^-]$ was examined by single-crystal X-ray crystallography ($(PS)H^+$ = protonated 1,8-bis(dimethylamino)naphthalene): P1, a = 8.241 (1) Å, b = 8.768 (2) Å, c = 12.591 (3) Å, α = 74.08 (2)°, β = 78.00 (2)°, γ = 80.23 (2)°, Z = 2, T = −106°C. Unlike other salts of the $OTeF_5{}^-$ anion, $[(PS)H^+][OTeF_5{}^-]$ did not exhibit any O/F disorder. Since the spectroscopic data for $[(PS)H^+][OTeF_5{}^-]$ closely matched those of $[N(n\text{-}Bu)_4{}^+][OTeF_5{}^-]$, it was concluded that this structure contains the best approximation of the structure of the free $OTeF_5{}^-$ anion. The librationally corrected results are Te-O = 1.803 Å, Te-F_{ax} = 1.872 Å, Te-F_{eq} = 1.870 Å (average), and O-Te-F_{eq} = 95.2° (average). A normal-coordinate analysis of $OTeF_5{}^-$ was carried out by using this geometry and spectroscopic data for the ^{16}O and ^{18}O equivalents of $[N(n\text{-}Bu)_4{}^+][OteF_5{}^-]$. 41 references, 5 figures, 8 tables.

42765 Starburst dendrimers. 5. Molecular shape control. Naylor, A.M. (California Institute of Technology, Pasadena (USA)); Goddard, W.A. III. *Journal of the American Chemical Society (USA),* 111(6): 2339-2341 (15 Mar 1989).

The recently reported starburst dendrimer and arborol systems provide unimolecular prototypes that allow for both endo-receptor and exo-supramolecular controlled molecular morphogenesis. This present communication describes the use of molecular simulation and reiterative generation development as a means for predicting and controlling molecular size and topology.

42766 Sonochemistry of Zn powder. Suslick, K.S. (Univ. of Illinois, Champaign (USA)); Doktycz, S.J. *Journal of the American Chemical Society (USA),* 111(6): 2342-2344 (15 Mar 1989). DOE Contract AC02-76ER01198.

High-intensity ultrasound can enhance both homogeneous and heterogeneous reactions. It has found an important niche in organic synthesis using reactive metals. Most investigations of heterogeneous sonochemistry, however, have been strictly descriptive. Although a detailed understanding of homogeneous sonochemistry has been recently developed, the authors knowledge about the effects of ultrasound on liquid-solid interfaces is much more limited. To better understand the origin of heterogeneous sonochemistry, they have examined the effects of ultrasonic irradiation on chemical reactivity, particle and surface morphology, and surface atomic composition of Zn powder. They believe that the observed changes are primarily due to interparticle collisions which result from the turbulent flow and shockwaves produced by the ultrasonic field.

42767 New synthesis of rhenium-carbene complexes from the reaction of $Cp(CO)_2ReH^-$ with $Cp_2Zr(\eta^2\text{-}COR)Cl$. Casey, C.P. (Univ. of Wisconsin, Madison (USA)); Nagashima, H. *Journal of the American Chemical Society (USA),* 111(6): 2352-2355 (15 Mar 1989).

Since the rearrangement of metal-carbene-hydride complexes to metal-alkyl complexes is a facile and well-studied process, it seemed likely that a zirconoxycarbene-meal complex might be further reduced if a hydride were present on the same metal as the carbene ligand. In an effort to prepare such a complex, the authors have studied the reaction of the η^2-acylzirconium compounds $Cp_2Zr(\eta^2\text{-}COR)Cl$ (3, R = CH_3; 4, R = $CH_2CH_2CMe_3$) with the rhenium hydride anion $K^+Cp(CO)_2ReH^-$ 5. It appeared plausible that formation of a Re-Zr bond in intermediate B might occur and that acyl migration from zirconium to rhenium might ensue to produce intermediate C which possess the desired zirconoxycarbene and hydride ligands on rhenium. They report the reaction of $\eta^2Cp(CO)_2ReH^-$ 5 leads not only to the reduction of the acyl ligand but also to formation of mononuclear rhenium-carbene complexes $Cp(CO)_2Re{=}CHR$ (8, R = CH_3, 9, R = $CH_2CH_2CMe_3$).

42768 Chemistry of a high-oxidation-level manganese porphyrin in aqueous solution. Spreer, L.O. (Lawrence Berkeley Lab., CA (USA)); Leone, A.; Maliyackel, A.C.; Otvos, J.W.; Calvin, M. *Inorganic Chemistry (USA),* 27(14): 2401-2405 (13 Jul 1988). DOE Contract AC03-76SF00098.

Manganese(III) tetrakis(N-methyl-4-pyridiniumyl)porphyrin ($Mn^{III}P^+$) (chloride salt) and other water-soluble manganese(III) porphyrins undergo facile one-electron electrochemical or chemical oxidation in alkaline solution. Best available evidence indicates that the final oxidized species is a manganese(IV) μ-oxo dimer, $PMn^{IV}\text{-}O\text{-}Mn^{IV}P^{2+}$. This same species is also produced by the reaction of manganese(II) porphyrin and oxygen. The Mn(IV) μ-oxo dimer has limited stability in water returning to 90-94% of the original Mn(III) porphyrin. The rate of this reaction is pH dependent with faster rates at lower pH. Oxygen is not produced during this reduction process. Rather, the reaction involves an unusual disproportionation in which a small percentage of the porphyrin macrocycles supply multiple electrons to rescue the remainder of the oxidized dimer. It was also found that the manganese(IV) dimer reacts rapidly with water-soluble olefins as it also does in aprotic solvent. A mechanism for the disproportionation reaction is discussed with a rate-determining step involving rearrangement of charge within the symmetric dimer to one with both oxidation equivalents on one metalloporphyrin unit,

viz., PMn^{IV}-O-$Mn^{III}P^{+}$ or PMn^{III}-O-$Mn^{III}P^{2+}$. This species undergoes nucleophilic attach by water or hydroxide, producing an isoporphyrin or bilirubin type molecule that has many olefinic bonds capable of reaction with remaining Mn(IV) μ-oxo dimer. Since coordination by OH^{-} to the manganese center favors the higher manganese(IV) oxidation level, the pH dependence of the disproportionation can be explained by rearrangement within the dimer to a porphyrin-centered oxidation site. 24 references, 3 figures.

42769 Synthesis and characterization of a complete series of $[MM'(dppm)_2(CH_3CN)_2](BF_4)_2$ complexes (M,M' = Ni, Pd, Pt). Miedaner, A. (Solar Energy Research Institute, Golden, CO (USA)); DuBois, D.L. *Inorganic Chemistry (USA)*, 27(14): 2479-2484 (13 Jul 1988).

A complete series of homo- and heterobimetallic complexes of the type $[MM'(dppm)_2(CH_3CN)_2](BF_4)_2$ (M, M' = Ni, Pd, Pt; dppm = $Ph_2PCH_2PPh_2$) have been prepared by comproportionation of appropriate M(0) and M'(II) complexes. These complexes have been characterized by ^{1}H NMR and ^{31}P NMR spectroscopy. NMR evidence shows that the acetonitrile ligands are labile for all complexes containing nickel and palladium. For certain heterobimetallic complexes, a second isomer is observed involving one bridging and one chelating dppm ligand while preserving the metal-metal bond. 33 references, 3 figures, 1 table.

42770 Reaction paths and generalized valley approximation. Walet, N. R. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104-6396 (US)); Klein, A.; Do Dang, G. *Journal of Chemical Physics (USA)*, 91(5): 2848-2858 (1 Sep 1989).

The generalized valley approximation has been developed as a method of approximately decoupling one or a few low-frequency nonlinear modes from the remaining higher frequency modes of a multiparticle system. This decoupling will be best when the difference in frequencies is large; this is the case of adiabatic motion. We describe the application of this method to chemical reactions, relying in some measure on our earlier work, and contrast it with reaction-path theories. We give an algorithm for the incorporation of our method in a chemical calculation of the Born–Oppenheimer type. Detailed calculations are reported for several standard models that couple a double well to a harmonic oscillator. The decoupling procedure leads to an effective or renormalized one-dimensional double-well problem. The energy splitting of the lowest doublet in this well is contrasted with the exact splitting obtained by numerical integration of the two-dimensional Schrödinger equation. Results are good when the adiabatic condition is well satisfied. For future applications the most important feature of our theory is that it allows the decoupling of more than one degree of freedom.

42771 A method to constrain vibrational energy in quasi-classical trajectory calculations. Bowman, J. M. (Department of Chemistry, Emory University, Atlanta, Georgia 30322 (US)); Gazdy, B.; Sun, Q. *Journal of Chemical Physics (USA)*, 91(5): 2859-2862 (1 Sep 1989).

In this paper, we present a general method to constrain the classical energy of a vibrational mode to be greater than a specified amount. In particular, zero-point energy constraints can be applied with this method to (zero-order) vibrational modes of a polyatomic system or complex. A demonstration of the method is made for a model two-mode Henon–Heiles Hamiltonian.

42772 Theoretical characterization of the lowest three potential surfaces of HNO. I. The potential for H atom addition to NO. Walch, S. P. (ELORET Institute, Sunnyvale, California 94087 (US)); Rohlfing, C. M. *Journal of Chemical Physics (USA)*, 91(5): 2939-2948 (1 Sep 1989).

The results of complete active space SCF/multireference contracted CI(CASSCF/CCI) calculations with large atomic natural orbital (ANO) basis sets are presented for the H + NO region of the lowest three potential surfaces of HNO ($^{1}A'$, $^{3}A''$, and $^{1}A''$). The calculations focus on the minimum energy path for H atom addition to the N end of NO and on the equilibrium geometry region of HNO and HON.

42773 High-pressure equations of state of krypton and xenon by a statistical mechanical theory. Kim, J. H. (Department of Chemistry, Korea Advanced Institute of Science and Technology, Cheongyangni, Seoul, Korea (KR)); Ree, T.; Ree, F. H. *Journal of Chemical Physics (USA)*, 91(5): 3133-3147 (1 Sep 1989).

We present statistical mechanical calculations for krypton and xenon, employing accurate pair potentials with and without condensed-phase modifications. A unique feature of the present work is that solid- and fluid-phase thermodynamic properties are *both* computed within a *single* framework, using our recently developed hard-sphere perturbation theory. Results are applied to analyze experimental fluid, solid, and fluid–solid transition data, ranging up to 2×10^{6} atmospheres at several temperatures. Effective pair potentials for both krypton and xenon, inferred from the analysis, contain short- and long-range modifications to the pair potential of Aziz and Slaman. The long-range correction is repulsive and originates from the well-known Axilrod–Teller three-body potential, while the short-range correction is attractive and is needed for describing high-compression data. Experimental isotherms above 50 GPa for xenon require a further softening of the short-range repulsion from Barker's correction (obtained from experimental data below 50 GPa). Implications of the short-range correction and its possible relation to many-body forces are discussed. Additional tests of the present rare-gas calculations against available computer simulations and Monte Carlo and lattice-dynamics calculations carried out in this work show satisfactory agreement. Computation of solid–fluid transition properties shows that the Axilrod–Teller three-body potential must be included to obtain reliable agreement with experimental melting and freezing data.

42774 Oxidation of a series of tris(polypyridyl)chromium(II) ions by several cobalt(III) complexes. Zahir, K. (Iowa State Univ., Ames (USA)); Espenson, J.H.; Bakac, A. *Inorganic Chemistry (USA)*, 27(18): 3144-3146 (7 Sep 1988). DOE Contract W-7405-ENG-82.

The kinetics of the outer-sphere oxidation of $Cr(NN)_3^{2+}$ ions (NN = 2,2'-bipyridine, 1,10-phenanthroline, and their substituted derivatives) by tris(chelating ligand) complexes of Co(III) were studied. The second-order rate constants increase with the driving force of the reaction. The rate constants for $Co(en)_3^{3+}$ at 23 ± 2°C increase from 2.2 (±0.3) × 10^{3} M^{-1} s^{-1} for $Cr(bpy)_3^{2+}$ to 1.1 (±0.2) × 10^{5} M^{-1} s^{-1} for $Cr(4,7\text{-}Me_2\text{-}phen)_3^{2+}$ and agree very well with the values calculated by the Marcus cross relation. For $Co(bpy)_3^{3+}$ and $Co(phen)_3^{3+}$, on the other hand, the experimental rate constants are lower than the calculated values. It is suggested that the reactions of these two species are mildly nonadiabatic, the extent of nonadiabaticity increasing with an increase in the standard free energy of the reaction. 22 references, 4 figures, 1 table.

42775 Reactions of the 17-electron bis(dimethylglyoximato)(triphenylphosphine)rhodium(II) radical. Howes, K.R. (Iowa State Univ., Ames (USA)); Bakac, A.; Espenson, J.H. *Inorganic Chemistry (USA)*, 27(18): 3147-3151 (7 Sep 1988). DOE Contract W-7405-ENG-82.

The indicated metal-centered radical arises from the laser-flash photolysis of the dinuclear complex $[Rh(dmgH)_2PPh_3]_2$. In the absence of other reagents the radical (which shows an absorption maximum at 580 nm, $\epsilon = 2 \times 10^{3}$ L mol^{-1} cm^{-1}) dimerizes rapidly, with $k_D = 2.3 \times 10^{8}$ L mol^{-1} s^{-1} in 95% ethanol. The metal-centered radical reacts rapidly with O_2, $k = 1.4 \times 10^{9}$ L mol^{-1} s^{-1}, with the first step assigned to the formation of a 1:1 oxygen adduct. This reaction ultimately yields hydrogen peroxide. The reactions between $Rh(dmgH)_2PPh_3$ and a wide range of alkyl halides have also been studied. The rate constants k_{RX} span a wide range, from ≈ 4 × 10^{2} ($CHCl_3$) to 9 × 10^{8} (CBr_4). There is an approximate correlation between log k_{RX} and the carbon-halogen bond dissociation energy. A correlation is also found with the half-wave potential for the reaction $RX + e^{-} \rightarrow R^{\cdot} + X^{-}$. The mechanism of the reactions with alkyl halides is discussed, and it seems probably that these reactions proceed by halogen atom abstraction. 24 references, 5 figures, 2 tables.

42776 Influence of variations in the chromophoric ligand on the properties of metal-to-ligand charge-transfer excited states. Johnson, S.R. (Univ. of North Carolina, Chapel Hill (USA)); Westmoreland, T.D.; Caspar, J.V.; Barqawi, K.R.; Meyer, T.J. *Inorganic Chemistry (USA)*, 27(18): 3195-3200 (7 Sep 1988). DOE Contract FG05-86ER13633.

The effects of variations in the chromophoric ligand on the properties of the metal-to-ligand charge-transfer (MLCT) excited states in the series $[Os(PP)_3]^{2+}$, $[(PP)_2Os(py)_2]^{2+}$, and $[(PP)_2Os(LL)]^{2+}$ (PP = 2,2'-bipyridine, 1,10-phenanthroline, or a substituted derivative; py = pyridine; LL = das, dppm, dppb, dppene) have been investigated. From a series of electrochemical and photophysical measurements it has been determined that (1) substituent variations in the chromophoric ligands have a relatively minor effect on the $d\pi(Os)$ levels as evidenced by variations in $E_{1/2}$ values for the ground-state Os(III/II) couples, (2) linear correlations exist between metal-to-ligand charge-transfer (MLCT) absorption or emission band energies and the difference in metal-based oxidation and ligand-based reduction potentials, $E_{1/2}(Os^{III/II})$ - $E_{1/2}(PP^{0/-})$, and (3) a linear relationship between 1n k_{nr} and the emission energy, E_{em}, exists, consistent with the energy gap law. It appears that for nonradiative decay both the pattern of acceptor vibrations and the vibrationally induced electronic coupling term remain relatively constant as the chromophoric ligand is varied. 26 references, 4 figures, 2 tables.

42777 Mean and Gaussian curvatures of randomly decorated Voronoi and cubic tesselations. Anderson, D. M. (Physical Chemistry 1, Chemical Center, S-221 00 Lund, Sweden (SE)); Davis, H. T.; Scriven, L. E. *Journal of Chemical Physics (USA),* 91(5): 3246-3251 (1 Sep 1989).

It is now generally accepted that some midrange microemulsions are bicontinuous, i.e., continuous in both oil and water simultaneously. The first model of the microstructure of microemulsion that could account for a progression from discrete to bicontinuous was the Talmon–Prager or "randomly decorated Voronoi" model. Space is tessellated into Voronoi polyhedra and the polyhedra are randomly decorated with oil and water. In variations of the model DeGennes and Taupin and Widom decorate a cubic tesselation of space. At first glance it might appear that the decorated Voronoi and cubic tessellations are zero-mean-curvature models, since they are constructed from polyhedra with planar faces. However, the edges of the polyhedra are concentrations of mean curvature, and the vertices are concentrations of Gaussian curvature. The area-averaged mean and Gaussian curvatures of the oil–water interface in the randomly decorated Voronoi and cubic models are calculated. The area-averaged mean curvatures of the two models are linear functions of oil volume fraction, change sign at a volume fraction of 0.5, and are within 0.2% of one another in magnitude. The area-averaged Gaussian curvature of the Voronoi model varies quadratically with volume fraction, and is negative for oil volume fractions from 0.18 to 0.82 (oil and water are bicontinuous for volume fractions ranging from 0.135 to 0.865). The area-averaged Gaussian curvature of the randomly decorated cubic model is a sixth-order polynomial function of oil volume fraction and is negative for volume fractions ranging from 0.23 to 0.77 (oil and water are bicontinuous over the volume fraction range 0.25 to 0.75). As an additional application, the model results are used to interpret curvature aspects of the bilayer theory of the L_3 phase of surfactant solutions presented recently by Cates *et al.* [Europhys. Lett. 5, 733 (1988)].

42778 Synthesis and characterization of $Mo(nor)_4$ (nor = 1-norbornyl). Kolodziei, R.M. (Massachusetts Institute of Technology, Cambridge (USA)); Schrock, R.R.; Davis, W.M. *Inorganic Chemistry (USA),* 27(18): 3253-3255 (7 Sep 1988). DOE Contract FG05-86ER75292.

A preparation of $Mo(nor)_4$ (nor = 1-norbornyl) is described in detail. The complex was found to be stable to oxygen but to decompose in the presence of moisture. $Mo(nor)_4$ did not react with pyridine, propylene oxide, 3-hexyne, 1 equivalent of CO, or 2,6-dimethylphenol in refluxing toluene. It was concluded that the large size of the molybdenum (IV) versus chromium (IV) is not enough to allow $Mo(nor)_4$ to react readily with small molecules, certainly not dinitrogen. 22 references, 2 figures.

42779 Thermodynamic studies of competitive adduct formation: single- and double-insertion reactions of carbon monoxide with rhodium octaethylporphyrin dimer. Coffin, V.L. (Univ. of Pennsylvania, Philadelphia (USA)); Brennen, W.; Wayland, B.B. *Journal of the American Chemical Society (USA),* 110(18): 6063-6069 (31 Aug 1988).

Reactions of carbon monoxide with (octaethylporphyrin)rhodium dimer, $[(OEP)Rh]_2$, in toluene produce and equilibrium system involving four species: $[(OEP)Rh]_2$ (1), $[(OEP)Rh]_2(CO)$ (2), (OEP)RhC(O)Rh(OEP) (3), and (OEP)RhC(O)C(C)Rh(OEP) (4). No evidence is found for the formation of a diacarbonyl adduct of 1, which is accounted for on the basis of required structural features of metal-metal-bonded porphyrin dimers. ^1H and ^{13}C NMR evidence is presented for double insertion of CO into the Rh-Rh bond. NMR methods are used to determine enthalpy and entropy changes for the reaction of 1 with CO to form the following: 2, $\Delta H_2° = -10\pm 1$ kcal/mol (-41 ± 4 kJ/mol), $\Delta S_2° = -26 \pm 4$ cal/K·mol–109 ± 17 J/K·mol; 3, $\Delta H_3° = -12 \pm 2$ kcal/mol (-50 ± 8 kJ/mol), $\Delta S_3° = -31 \pm 5$ cal/K·mol (-130 ± 21 J/K·mol); 4, $\Delta H_8° = -21 \pm 2$ kcal/mol ($-88 \pm$ kJ/mol), $\Delta S_8° = -62 \pm 5$ cal/K·mol (-259 ± 30 J/K·mol). Thermodynamic criteria for the double insertion of CO into metal-metal bonds are presented and applied to the (OEP)Rh system.

42780 Synthesis, structure, and reactions of chiral rhenium vinylidene and acetylide complexes of the formula $[(\eta^5\text{-}C_5H_5)Re(NO)(PPh_3)(X)]^{n+}$: vinylidene complexes that are formed by stereospecific C_β electrophilic attack, exist as two Re=C=C geometric isomers, and undergo stereospecific C_α nucleophilic attack. Senn, D.R. (Univ. of Utah, Salt Lake City (USA)); Wong, A.; Patton, A.T.; Marsi, M.; Strouse, C.E.; Gladysz, J.A. *Journal of the American Chemical Society (USA),* 110(18): 6096-6109 (31 Aug 1988).

In this paper, the authors report (a) high-yield syntheses of chiral rhenium vinylidene complexes $[(\eta^5\text{-}C_5H_5)Re(NO)(PPh_3)(=C=CRR')]^+X^-$ and acetylide complexes $(\eta^5\text{-}C_5H_5)Re(NO)(PPh_3)(C\equiv CR)$, (b) the first observation of M—C—C geometric isomerism in vinylidene complexes, (c) the thermal and photochemical interconversion of these geometric isomers and the corresponding rates and activation parameters, (d) examples of stereospecific C_α nucleophilic attack upon the vinylidene complexes and stereospecific C_β electrophilic attack upon the acetylide complexes, and (e) X-ray crystal structures that establish the stereochemistry of these transformations and bonding features of both types of complexes. A portion of this study has been communicated.

42781 Divergent kinetic and thermodynamic acidity in organotransition-metal hydride complexes: synthesis, structure, and reactivity of the rhenium anion of $Li^+[(\eta^5\text{-}C_5H_5)Re(NO)(PPh_3)]^-$. Crocco, G.L. (Univ. of Utah, Salt Lake City (USA)); Gladysz, J.A. *Journal of the American Chemical Society (USA),* 110(18): 6110-6118 (31 Aug 1988).

Reaction of hydride complex $(\eta^5\text{-}C_5H_5)Re(NO)(PPh_3)(H)$ (1) and n-BuLi/TMEDA (THF, −78°C) gives $(\eta^5\text{-}C_5H_4Li)Re(NO)(PPh_3)(H)(Li^+\text{-}8)$, as shown by ^{31}P NMR monitoring, deuterium labeling, and methylation ($CH_3OSO_2CF_3$, −78°C) to $(\eta^5\text{-}C_5H_4CH_3)Re(NO)(PPh_3)(H)$ (9, 52%). Complex Li^+-8 rearranges to the rhenium anion of $Li^+[(\eta^5\text{-}C_5H_5)Re(NO)(PPh_3)]^-$ (Li^+-3; −32°C, 0.5 h) with $\Delta H^\ddagger = 11.3 \pm 0.5$ kcal/mol, $\Delta S^\ddagger = -26.2 \pm 1.4$ eu, and k_H/k_D (−22.4°C) = 1.16 ± 0.08. Crossover experiments show hydrogen migration to be intramolecular, and K^+-8 rearranges ca. 10^4 faster than Li^+-8 at −91.6°C. Equilibration experiments show the $\eta^5\text{-}C_5H_5$ and ReH proton pK_a's (THF) in 1 to be ca. 36 and 26-30, respectively. Thus, the less acidic proton is abstracted kinetically, and a rationale is proposed. Reactions of Li^+-3 with alkylating agents (CH_3I, n-C_4H_9I, $ClCH_2CH{=}CH_2$, $ClCH_2COPh$), benzoic anhydride, and D_2O give the corresponding alkyl, acyl, and deuteride complexes (56-90%). IR data show Li^+-3 to be a mixture of three ion pairs in THF. Pentamethyl analogue $(\eta^5\text{-}C_5Me_5)Re(NO)(PPh_3)(H)$ (13) is prepared from methyl complex $(\eta^5C_5Me_5)Re(NO)(PPh_3)(CH_3)$ (11; HCOOH, then 110°C; 43%). Reaction of 13 and n-BuLi/K^+-t-BuO^- gives principally $K^+[(\eta^5\text{-}C_5Me_5)Re(NO)(PPh_3)]^-$, as assayed by ^{31}P NMR and methylation (CH_3I) to 11.

42782 Peptide way to macrocylic bifunctional chelating agents: synthesis of 2-(p-nitrobenzyl)-1,4,7,10-tetraazacyclododecane-N,N',N'',N'''-tetraacetic acid and study of its yttrium(III) complex. Moi, M.K. (Univ. of California, Davis (USA)); Meares, C.F.; DeNardo, S.J. *Journal of the American Chemical Society (USA),* 110(18): 6266-6267 (31 Aug 1988). DOE Contract FG03-84ER60233.

Monoclonal antibody technology allows the specificity of an antibody for its antigen to be used in targeting cancer cells. The conjugation of metals—particularly radionuclides such as ^{90}Y or ^{67}Cu— to monoclonal antibodies results in agents for radiommunotherapy and other medical applications. Chelators that can hold radiometals with high stability under physiological conditions are essential to avoid excessive radiation damage to nontarget cells. Macrocylic polyamines, the key precursors to macrocyclic bifunctional chelating agents, are synthesized by bimolecular cyclizations. Competition between polymerization and the desired cyclization is a common problem; the authors efforts to form a 12-membered macrocycle cyclizations gave unsatisfactory yields. They have developed a new synthetic route to these macrocycles via peptide synthesis and intramolecular tosylamide ring closure. For polyazamacrocyles with nitrogens separated by two-carbon chains, peptides made from α-amino acids are readily accessible starting materials. Treatment with borane converts peptides to linear polyamino alcohols, in which the original peptide backbone has been converted to a C-terminal alcohol, an N-terminal primary amine, and internal secondary amines (Figure 1, step 1). Treatment with p-toluenesulfonyl chloride produces a C-terminal tosyl ester, an N-terminal secondary tosylamide, and internal tertiary tosylamides. Treatment with mild base converts the N-terminal tosylamide to a nucleophlie which displaces the C-terminal tosyl ester and thus forms a macrocyclic ring in high yield. This intramolecular cyclication may be performed in very dilute solution, eliminating concerns about polymer formation.

42783 Gas-phase chemistry of transition of metal-imido and -nitrene ion complexes. Oxidative addition of N-H bonds in NH_3 and transfer of NH from a metal center to an alkene. Buckner, S.W. (Purdue Univ., West Lafayette, IN (USA)); Gord, J.R.; Freiser, B.S. *Journal of the American Chemical Society (USA),* 110(20): 6606-6612 (28 Sep 1988). DOE Contract FG02-87ER13766.

The gas-phase chemistry of a number of bare transition metal-nitrene and -imido ion complexes, MNH^+ are reported herein. Group 3, 4, and 5 atomic metal ions react with NH_3 at thermal energies to generate MNH^+ via dehydrogenation. A reaction mechanism is proposed involving initial oxidative addition to an N-H bond, in analogy to mechanisms proposed for reactions of gaseous atomic metal ions with hydrocarbons. Cr^+ reacts with NH_3 via slow condensation to form $CrNH_3^+$, as do all group 6-11 atomic metal ions investigated. However, excited-state Cr^+ reacts with NH_3 via bond-insertion reactions to form $CrNH_2^+$ and $CrNH^+$. An unidentified metastable electronic state of Cr^+, produced by direct laser desorption of chromium foil, reacts with much higher efficiency than does kinetically excited Cr^+. FeO^+ reacts with NH_3 to generate $FeNH^+$ with loss of H_2O. Thermochemical studies of VNH^+ and $FeNH^+$ involving ion-molecule reactions indicate values of $D°(V^+\text{-NH}) = 101 \pm 7$ kcal/mol and $D°(Fe^+\text{-NH}) = 54 \pm 14$ kcal/mol, the latter value in accord with $D°(Fe^+\text{-NH}) = 61 \pm 5$ kcal/mol obtained from photodissociation. The high bond strength for VNH^+ indicates multiple bonding, analogous to that in the isoelectronic VO^+, while the weaker bond strength for $FeNH^+$ indicates a single bond, analogous to that in the isoelectronic FeO^+. Proton-transfer experiments indicate $PA(VN) = 220 \pm 4$ kcal/mol from which $\delta H_f(VN) = 111 \pm 9$ kcal/mol and $D°(V\text{-N}) = 125 \pm 9$ kcal/mol are obtained. VNH^+ is unreactive with ethene and benzene, but $FeNH^+$ transfers NH to ethene and benzene through metathesis and homologation reactions. 41 references, 2 figures, 2 tables.

42784 Appearance potentials of $C_nH_{2n+2}N^+$ Ions (n = 1-3). Sigsworth, S.W. (Pennsylvania State Univ., University Park (USA)); Keesee, R.G.; Castleman, A.W. Jr. *Journal of the American Chemical Society (USA),* 110(20): 6682-6684 (28 Sep 1988). DOE Contract AC02-82ER60055;FG02-88ER60668.

Considerable discrepancy exists in the literature over the appearance potentials for $C_nH_{2n+2}N^+$ ions arising from mono-, di-, and trimethylamine. Through observation of the reactions of the parent molecules with selected metal ions in a flow tube apparatus, both upper and lower limits are determined for the appearance potentials. For $AP(C_2H_6N^+)$ and $AP(C_3H_9N^+)$, 9.9 ± 0.1 eV is the upper limit and 9.2 ± 0.2 eV is the lower limit, while for CH_4N^+ the values are $9.9 \pm 0.1 \leq 10.6 \pm 0.1$ eV. 21 references, 4 tables.

42785 Modeling the dinuclear sites of iron biomolecules: synthesis and properties of $Fe_2O(OAc)_2Cl_2(bipy)_2$ and its use as an alkane activation catalyst. Vincent, J.B. (Indiana Univ., Bloomington (USA)); Huffman, J.C.; Christou, G.; Li, Q.; Nanny, M.A.; Hendrickson, D.N.; Fong, R.H.; Fish, R.H. *Journal of the American Chemical Society (USA),* 110(20): 6898-6900 (28 Sep 1988). DOE Contract AC03-76SF00098.

A procedure is described that employs 2,2'-bipyridine to successfully allow access to a $[Fe_2O(O_2CR)_2]^{2+}$ product. The structure, properties, and alkane activation reactivity of $Fe_2O(OAc)_2Cl_2(bipy)_2$ possessing Cl^- ligands bound to the now available sixth coordination sites are described. 22 references, 1 figure, 1 table.

42786 Biosynthesis of pyrroloquinoline quinone. 1. Identification of biosynthetic precursors using ^{13}C labeling and NMR spectroscopy. Houck, D.R. (Los Alamos National Lab., NM (USA)); Hanners, J.L.; Unkefer, C.J. *Journal of the American Chemical Society (USA),* 110(20): 6920-6921 (28 Sep 1988).

The biosynthesis of pyrroloquinoline quinone (PQQ) in the methylotropic bacterium methylobacterium AM1 has been investigated using ^{13}C-labelling of the products and NMR spectroscopy. The data indicated that the quinoline portion of PQQ is formed by a novel condensation of N-1, C-2, -3, and -4 of glutamate with a symmetrical six-carbon ring derived from the shikimate pathway. It is postulated that tyrosine is the shikimate-derived percursor, since pyrrole could be formed by the internal cyclization of the amino acid backbone. 18 references, 2 figures, 2 tables.

4004 Electrochemistry

Refer also to citation(s) 41461, 42202, 42212, 42213, 42292, 42793, 42800

42787 (WCWS–8409, pp. 17-27) **Technical and economical advantages of producing and applying ozone at high concentration.** Fischer, M. (BBC Brown, Boveri & Co., Baden, Switzerland); Klein, H.P; Liechti, P.A.; Dyer-Smith, P. Western Canada Water and Sewage, Calgary, AB (Canada). 1984. (CONF-8409417–: Western Canada water and sewage conference, Calgary (Canada), 19-21 Sep 1984; CE–02683). In *Proceedings of the [36th annual] western Canada water and sewage conference.* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

For practical reasons high ozone concentrations in feed gas is desirable for many processes. This includes ozone applications in water treatment and chemical processes in industry since mass transfer, solubility and reaction rate depend on ozone concentrations in gas and liquid phases. High ozone concentrations can only be achieved economically at high production densities and low specific energy consumption. Until recently this has been difficult to achieve. This paper discusses the production of ozone in a high frequency alternating current which produces ozone several times more efficiently than was formerly possible. A modern ozonator working on frequencies from 600 to 1000 Hz can opeate with a power density of 3 to 4 kW/m2 and a production density of 0.2 to 0.25 kg/hm2 in air and 0.35 to 0.45 kg/hm2 in oxygen at an electron voltage if not more than 10kV rms. Specific energy consumption at 3 weight 5 production of ozone in air is typically about 17 kWh/kg. When oxygen is used as a feed gas 6 weight % ozone can be achieved at 9.5 kWh/kg. Also discussed are operations at three plants, in Los Angeles, in Dordrecht, Netherlands and in Jeddah, South Arabia, which use high frequency ozone generators to produce portable water. Operating cost parameters are discussed. 6 refs., 8 figs.

42788 Electrocatalysis of anodic oxygen transfer reactions. Chang, H. (9509106); Johnson, D.C. *Journal of the Electrochemical Society (USA),* 136(1): 23-26 (Jan 1989).

An Au rotated ring-disk electrode (RRDE) was applied for the detection of soluble intermediate products during the anodic electrodeposition and cathodic dissolution of β-PbO_2 in solutions of $HClO_4$. A soluble species which only can be reduced at the ring electrode is produced during the anodic nucleation and deposition processes for PbO_2(s) at the disk electrode. This soluble intermediate product is concluded to be Pb(IV) which is probably associated with oxygen, e.g., PbO^{2+} or $Pb(PH)_2^{2+}$. The cathodic ring current

from detection of the soluble Pb(IV) species was studied as a function of the concentrations of Pb(II) and $HClO_4$, and variation of rotational velocity. The results are consistent with chronamperometric data for PbO_2(s) deposition described previously. Soluble Pb(IV) and Pb(III), as well as Pb(II), are concluded to be products of the cathodic dissolution of PbO_2(s).

42789 Surface modification and oxygen reduction on glassy carbon in chloride media. Sundberg, K.M. (4234000); Smyrl, W.H.; Atanasoska, L.; Atanasoski, R. *Journal of the Electrochemical Society (USA),* 136(2): 434-438 (Feb 1989).

The reduction of oxygen on rotating disk glassy carbon electrodes was studied in 0.1M HCl. Reproducible single waves with constant limiting currents over a potential range of 0.5V were obtained after the samples were electrochemically treated: anodic polarization at 2.0V vs. SCE and subsequent cathodic reduction. The number of electrons transferred in the oxygen reduction reaction was calculated to be 2.3. The surface of the glassy carbon was examined by XPS at different stages of the electrochemical treatment. After the anodic treatment, the ratio of oxidized carbon vs. graphitic carbon was higher than 1. The predominant oxygen species were carbonyl groups. Following reduction, the surface had an oxidized vs. graphitic carbon ratio below 0.5 with the oxygen distributed between phenolic and carboxylic groups. The role of the chloride ion in the formation of the carbonyl groups is discussed.

42790 STM observations of electrodeposited copper under potential control and open circuit. Armstrong, M.J. (9522384); Muller, R.H. *Journal of the Electrochemical Society (USA),* 136(2): 584-585 (Feb 1989).

Applications of scanning tunneling microscopy (STM) to electrochemical metal deposition and oxidation have been reported by several researchers. Open circuit conditions are encountered during transfer of electrochemical deposits for ex-situ measurements. In the present work, the topography of Cu deposit under potential control and at open circuit has been investigated by STM. Some preliminary results are reported here from a deposit of Cu on Pt from a 5 mM $Cu(ClO_4)_2$ and 0.5 M $NaClO_4$ solution of pH 2.

4005 Photochemistry

Refer also to citation(s) 42554, 42775, 42780, 42800, 42883, 43018, 43780

42791 (ORNL/M–500, pp. 29-37) **Chemical kinetics of enzyme catalyzed reactions.** Greenbaum, E.; Woodward, J. Oak Ridge National Lab., TN (USA). 1988. In *Research programs for Division of Chemical Sciences, Office of Basic Energy Sciences, Department of Energy.* Order Number DE89003693/JAW. Available from NTIS, PC A03/MF A01.

The project on Chemical Kinetics of Enzyme Catalyzed Reactions is focused on four research areas: (1) kinetic studies; (2) fundamentals of light energy conversion; (3) electron transfer reactions at metal-membrane interfaces; and (4) fundamentals of immobilization and chemical modification of cellular organelles and enzymes.

42792 Photoreactions of $Ir_8(CO)_{22}^{2-}$. Homolytic cleavage of an unsupported metal-metal bond linking two tetrahedral iridium carbonyl clusters. Vandenberg, D.M. (Univ. of California, Santa Barbara (USA)); Friedman, A.E.; Ford, P.C. *Inorganic Chemistry (USA),* 27(4): 594-595 (24 Feb 1988). DOE Contract FG03-85ER13317.

The photolysis of an anion, $Ir_8(CO)_{22}^{2-}$, where the metal-metal bond links two polyhedral metal clusters is discussed herein. The photolytic reaction apparently leads to homolytic bond cleavage to yield the reactive anion $Ir_4(CO)_{11}^-$. The photolysis of a complex incorporating the named anion was studied in dichloromethane under N_2 and in tetrahydrofuran under CO. The relative reactivity of the intermediate, $Ir_4(CO)_{11}^-$ is illustrated by its ability to extract a chlorine atom from dichloromethane. The results of the photolysis study indicated that the tetrairidium radical may be sufficiently reactive to abstract a hydrogen atom from tetrahydrofuran. 13 references, 1 figure.

42793 Photoelectrochemical reduction of a Cu(I) complex to copper metal by hot electrons at p-InP. Koval, C.A. (Univ. of Colorado, Boulder (USA)); Segar, P.R. *Journal of the American Chemical Society (USA),* 111(6): 2004-2010 (15 Mar 1989). DOE Contract FG02-84ER13247.

The chemically irreversible reduction of copper(I) (trans-diene)$^+$ to copper metal has been used to confirm the existence of hot-electron processes at the p-InP/acetonitrile interface. Although hot-carrier processes have been previously reported, this is the first observation of a chemical product produced by a hot-carrier reaction in a photoelectrochemical cell. Band-edge positions have been determined by capacitance measurements done under conditions identical with the hot-carrier copper-plating experiments. Supraband-edge production of Cu(O) occurred at high-doped (1.2×10^{18} cm^{-3}) p-InP but was observed at low-doped (8×10^{15} cm^{-3}) samples. For the high-doped electrode, a quantum yield for production of copper by hot electrons of 0.25% was measured, but this represents only a lower limit to the actual quantum yield for hot electrons since the hot-carrier probe reaction must complete with other processes. Nearly identical quantum yields were measured with both 632.8- and 543.5-nm illumination; however, the intensity profile across the electrode surface has a dramatic effect on the quantum yield.

42794 Clusters containing carbene ligands. The unusual synthesis, coordination, and reactivity of a bridging (dimetalliomethyl)(diethylamino)carbene ligand in the cluster complex $Os_3(CO)_9[\mu_3\text{-}HCC(NEt_2)](\mu\text{-}H)_2$. Adams, R.D. (Univ. of South Carolina, Columbia (USA)); Tanner, J.T. *Organometallics (USA),* 7(10): 2241-2243 (Oct 1988).

The photoinduced decarbonylation of $Os_3(CO)_{10}[\mu\text{-}C(H)C(H)NEt_2](\mu\text{-}H)$ (1) yields $Os_3(CO)_9[\mu_3\text{-}CC(H)NEt_2](\mu\text{-}H)_2$ (2; 58% yield) and $Os_3(CO)_9[\mu_3\text{-}C(H)CNEt_2](\mu\text{-}H)_2$ (3; 21% yield). Compound 3 was also obtained from 2 in 70% yield by heating to 68°C in hexane solvent. Both products were characterized by IR, ^1H NMR and X-ray diffraction analysis. Compound 2 contains and π^1-triply bridging (diethylamino)alkenylidene ligand coordinated to a triangular triosmium cluster. Compound 3 contains a triply bridging HC_2NEt_2 ligand that is formulated to include two osmiums as a (dimetalliomethyl)(diethylamino)carbene ligand on the basis of structural and reactivity evidence. Compound 3 reacts with $NHPr^n_2$ to yield $Os_3(CO)_9[\mu_3\text{-}C(H)CNPr^n_2](\mu\text{-}H)_2$ (4) in 74% yield by replacement of the diethylamino group.

42795 Electron-transfer photofragmentation reactions: analogies and divergences of the reactivity of ditertiary amines as compared with aminoalcohols. Kellett, M.A. (Univ. of Rochester, NY (USA)); Whitten, D.G. *Journal of the American Chemical Society (USA),* 111(6): 2314-2316 (15 Mar 1989). DOE Contract FG02-86ER13504.

The electron-transfer quenching of excited acceptors by amines and subsequent chemical reactions have been topics of extensive study. Among the various reactions of the photogenerated radical ion pairs, fragmentation via C-C bond cleavage has been shown to be prominent and often a chemically clean path for aminoalcohols, aminoketones, and other systems, recent experiments have shown that the dehydrofragmentation of aminoalcohols is strongly acceptor-dependent and consistent with a mechanism in which the acceptor anion radical acts as a base to promote cleavage of the donor cation radical in a reaction closely analogous to the two-electron Grob fragmentation. The authors report here studies of the photooxidative fragmentation of 1,2-ditertiary amines, a reaction which is probably also quite general and which shows both similarities and yet remarkable contrasts to the aminoalcohol cleavage.

42796 A state-selected study of the unimolecular decomposition of $C_2H^+_2(\tilde{A},\tilde{B})$ using the photoion–photoelectron coincidence method. Norwood, K. (Ames Laboratory, U. S. Department of Energy and Department of Chemistry, Iowa State University, Ames, Iowa 50011 (US)); Ng, C. Y. *Journal of Chemical Physics (USA),* 91(5): 2898-2900 (1 Sep 1989). DOE Contract W-7405-ENG-82.

The photoion–photoelectron coincidence spectra for C_2H^+ and $C_2H^+_2$ have been measured in the wavelength range of 645–765 A. The $C_2H^+_2(\tilde{A}\ ^2A_g,\tilde{B}\ ^2\Sigma^+_u)$ ions prepared with internal energies above 17.39 eV are found to dissociate completely into C_2H^++H in

the temporal range <12 μs. An upper bound of 17.33±0.05 eV is determined for the appearance energy of the process $C_2H_2+h\nu \rightarrow C_2H^+ + H + e^-$ at 0 K.

42797 IR flash kinetic spectroscopy of transients generated by irradiation of $(\eta^5\text{-}C_5H_5)Co(CO)_2$ in the gas phase and in solution. Wasserman, E.P. (Univ. of California, Berkeley (USA)); Bergman, R.G.; Moore, C.B. *Journal of the American Chemical Society (USA)*, 110(18): 6076-6084 (31 Aug 1988). DOE Contract AC03-76SF00098.

The photoinduced ligand substitution chemistry of $(\eta^5\text{-}C_5H_5)Co(CO)_2$ in the gas and solution phases has been studied by using laser flash kinetic spectroscopy with fast IR detection. The data are consistent with primary loss of one CO to form an unsaturated species which then reacts with ligands such as C_2H_4 in the gas phase of with $P(n\text{-}C_4H_9)_3$ in cyclohexane solution. The rates of bimolecular ligand addition reactions have been measured for several ligands. In general, the unsaturated intermediate reacts with ligands at rates close to those of diffusion in both media, which indicates that the open site of the coordination sphere may be only weakly solvated in alkane solutions. Solvation complexes of this intermediate with benzene and tetrahydrofuran in cyclohexane solution were produced; these solvates are far less than the cyclohexane solvate. The benzene solvate appears to react with ligand through both direct and indirect pathways. The rate constants for these reactions have been determined.

4006 Radiation Chemistry

Refer also to citation(s) 41660, 41661, 41716, 42665, 42888, 43180, 43607

42798 (AD-A-207039/9/XAB) **Radiolysis of poly(acetaldehyde-co-chloral), a positive E-beam resist. Technical report.** Zhao, X.; Khanna, D.N.; Xu, B.; Chien, J.C. Massachusetts Univ., Amherst, MA (USA). Dept. of Chemistry. 1987. 42p. Available from NTIS, PC A03/MF A01.

Basic study of the radiation chemistry of polymers is needed both for the understanding of interaction of radiation with matter and for various technological applications. In the context of microelectronic lithography, polymers that undergo radiation-induced crosslinking or scission are useful as negative or positive resists, respectively. There is a natural amplification of the physical effects of a radiolytic event. In the former case, the formation of crosslinks insolubilizes the macromolecules. In the latter case, the occurrence of one main-chain scission can render the macromolecule more soluble than the parent polymer. Latent images can be developed by these solubility changes. Direct imaging is possible for positive acting resists if radiation cause complete degradation of the polymer into volatile products. Such system may be referred to as self-developing, and has the distinct advantages of simplicity and economy. Radiolysis initiates the unzipping process to convert the entire macromolecule into its monomer without side reactions. Acetaldehyde and chloral were copolymerized using triethyl aluminum catalyst. Radiolysis in vacuo caused depolymerization with a G(M) value (number of monomers produced per 100 eV) of about 4000 to 80% completion. Gamma radiolysis sensitized by diphenyl Hexa-fluoro-iodophosphate (C6H5)2IPF6 has G(M) value of 327000. The E-beam sensitivity of ACC is about 3×10^{-2} c/sqcm.

42799 (AECL–9089) **Review of iodine chemistry under severe accident conditions.** Clough, P.M.; Starkie, H.C.; Wren, D.J.; Paquette, J.; Wren, J.C. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 51p. Order Number DE89634904/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

This report reviews the progress that has been made in establishing a basic understanding of the factors which will determine the behaviour of iodine during postulated accidents in water-cooled reactors. The topics considered are thermal reactions, radiolytic reactions, impurity effects, organic iodide formation, integral models and tests and volatility control. There have been substantial gains in a number of areas, most notably in the kinetics and thermodynamics databases for thermal and radiolytic reactions of inorganic iodine in solution. However, there remains a limited understanding of the mechanisms controlling the formation of organic iodides and a need for integral tests of iodine behaviour in complex, 'dirty' systems to provide data for the validation of chemical models which are undergoing development. 81 refs.

42800 (DOE/ER/00038–3215) **Radiation Laboratory, University of Notre Dame: Quarterly report, April 1–June 30, 1989.** Notre Dame Univ., IN (USA). Radiation Lab. 12 Jul 1989. 51p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER00038. (NDRL–3215;Q–128). Order Number DE89015325/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Research carried out at the Notre Dame Radiation Laboratory is briefly described. Research involves areas of electron transfer photoprocesses, photochemistry, pulse radiolysis, and charge transfer reactions. (CBS)

42801 (INIS-mf–11483, pp. 17) **Use of aqueous solutions of glucose for dose measurements with UV-spectroscopy and biosensor application.** Prokert, K. (Technische Univ., Dresden (German Democratic Republic)); Grewi, A. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

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42802 (INIS-mf–11494, pp. 11) **Radiation and chemistry.** Sangster, D.F. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

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42803 (INIS-mf–11494, pp. 12) **Radiation chemistry of ascorbic acid and dehydroascorbic acid.** Turonek, M.L. (Adelaide Univ. (Australia). Dept. of Physical and Inorganic Chemistry); Laurence, G.S. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

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42804 (INIS-mf–11494, pp. 13) **Polymerisation of microemulsions.** Mann, R.A. (Sydney Univ. (Australia). School of Chemistry); Gilbert, R.G.; Napper, D.H.; Sangster, D.F. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

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42805 (INIS-mf–11494, pp. 14) **Electrochemical monitoring of the transient products of pulse radiolysis.** Green, T.A. (Western Australia Univ., Nedlands (Australia)); Quickenden, T.I.; Sangster, D.F. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

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42806 (INIS-mf–11494, pp. 15) **Superoxide radical reactions with metal complexes.** McLay, P.J. (Murdoch Univ., WA (Australia). School of Mathematical and Physical Sciences); May, P.M.; Hefter, G.T. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42807 (INIS-mf–11494, pp. 16) **Redox reactions, reduction potentials and bond dissociation free energies of some radicals in aqueous solutions.** Armstrong, D.A. (Calgary Univ., AB (Canada)); Surdhar, P.S.; Mezyk, S.P. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42825 (INIS-mf–11494, pp. 35) **Interpretation of polymerization kinetics with radical initiation.** McCarthy, S.J. (Monash Univ., Clayton (Australia). Dept. of Chemistry); Coller, B.A.W.; McKinnon, I.R.; Wilson, I.R. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42829 (INIS-mf–11494, pp. 39) **Radiation degradation of copolymers of styrene and methacrylic acid.** Campbell, K.T. (Queensland Univ., St. Lucia (Australia). Dept. of Chemistry); Hill, D.J.T.; O'Donnell, J.H.; Pomery, P.J. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42837 (INIS-mf–11494, pp. 47) **New instruments for measuring chemical reaction rates in γ fluxes : computer-control of a calorimeter and simple dilatometer.** King, D.G. (Monash Univ., Clayton (Australia). Dept. of Chemistry); McKinnon, I.R. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42838 (INIS-mf–11494, pp. 48) **Kinetics of dissolution of ionic substances.** Coller, B.A.W. (Monash Univ., Clayton (Australia). Dept. of Chemistry); Wilson, I.R. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42839 (INIS-mf–11494, pp. 49) **Difficulties associated with the electrochemical determination of radiolytic products.** Green, T.A. (Western Australia Univ., Nedlands (Australia)); Quickenden, T.I.; Sangster, D.F. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42841 (INIS-mf–11494, pp. 51) **Effect of crystal fragmentation on the electron excited luminescence from ice.** Bakker, M.G. (Western Australia Univ., Nedlands (Australia)); Quickenden, T.I.; Vernon, C.F.; Sangster, D.F.; Freeman, C.G. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42842 (INIS-mf–11494, pp. 53) **Use of DNA sequence techniques to analyse DNA damage.** Martin, R.F. (Peter MacCallum Cancer Inst., Melbourne (Australia)); D'Cunha, G.; Pardee, M. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42843 (INIS-mf–11494, pp. 54) **Radiation induced dissolution of colloidal manganese and iron oxides.** Mulvaney, P. (Melbourne Univ., Parkville (Australia). Dept. of Physical Chemistry); Grieser, F.; Cooper, R.; Meisel, D. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42844 (INIS-mf–11494, pp. 55) **Application of pulse radiolysis to the chemistry of radiobiology.** Fielden, E.M. (Medical Research Council, Chilton (UK). Radiobiology Unit). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42845 (INIS-mf–11494, pp. 56) **Protein peroxidation by hydroxyl radicals.** Gebicki, J.M. (Macquarie Univ., North Ryde (Australia). School of Biological Sciences); Van Oorshot, G.; Winn, J. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42846 (INIS-mf–11494, pp. 58) **Radical induced degradation of organic halogen compounds; radiation chemical model studies related to other fields.** Asmus, K.D. (Hahn-Meitner-Institut Berlin G.m.b.H. (Germany, F.R.). Bereich Strahlenchemie). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42847 (INIS-mf–11494, pp. 59) **Free radicals as tools for inorganic chemistry - 25 years of radiation chemistry across the periodic table.** Laurence, G.S. (Adelaide Univ. (Australia). Dept. of Physical and Inorganic Chemistry). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42848 (INIS-mf–11494, pp. 60) **Free radicals and their role in some aspects of human endeavour : chemical evolution of life on a planet's surface and fire-control in aircraft.** Ling, A.C. (San Jose State Univ., CA (USA)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42849 (INIS-mf–11494, pp. 61) **Radiation studies on anticancer drugs.** Anderson, R.F. (Mount Vernon Hospital, Northwood (UK). Gray Lab.); Packer, J.E.; Denny, W.A.; Sutton, B.M.; O'Connor, C.J.; Wilson, W.R. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42850 (INIS-mf–11494, pp. 62) **New light on the mechanisms for luminescence emission in electron-irradiated ice.** Quickenden, T.I. (Western Australia Univ., Nedlands (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42851 (INIS-mf–11494, pp. 63) **Temperature dependence of the luminescence from electron pulse-irradiated H_2O ice.** Bakker, M.G. (Western Australia Univ., Nedlands (Australia)); Matich, A.J.; Quickenden, T.I.; Sangster, D.F. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42852 (INIS-mf–11494, pp. 64) **On the role of hydrogen and hydroxyl ions in thermoluminescence and other radiolysis processes in solids.** Boas, J.F. (Australian Radiation Lab., Melbourne (Australia)); Young, J.G. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.
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42853 (INIS-mf–11503, pp. 117) **Use of photoacustic spectroscopy (PAS) in radiation chemistry of powders.** Kushelevsky, A.P. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering); Slifkin, M.A. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
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42854 (INIS-mf–11989, pp. 223) **Identification of decomposition products of extraction systems based on the solutions of tri-n-butyl phosphate in aliphatic hydrocarbons.** Adamov, V.M. (Radievyj Inst., Leningrad (USSR)); Andreev, V.I.; Belyaev, B.N.; Markov, G.S.; Polyakov, M.S.; Ritari, A.E.; Shilnikov, A.Yu. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.
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42855 (INIS-SU–104/A, pp. 4-5) **Thermokinetic oscillations of reaction rate in low-temperature radiation-induced chain processes.** Kiryukhin, D.P. (AN SSSR, Chernogolovka (USSR). Otdelenie Inst. Khimicheskoj Fiziki); Kichigina, G.A.; Bol'shakov, A.I.; Barkalov, I.M. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.
Short note; 4 refs.

42856 (INIS-SU–104/A, pp. 6-7) **Rapid waves of cryochemical transformation in samples which were undergone to photolysis and radiolysis.** Kiryukhin, D.P. (AN SSSR, Chernogolovka (USSR). Otdelenie Inst. Khimicheskoj Fiziki); Mozhaev, P.S.; Zanin, A.M.; Barelko, V.V.; Barkalov, I.M. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.
Short note; 3 refs.

42857 (INIS-SU–104/A, pp. 8-9) **Autowave processes in ionic polymerization reactions initiated by sample brittle failure at 77 K.** Kichigina, G.A. (AN SSSR, Chernogolovka (USSR). Otdelenie Inst. Khimicheskoj Fiziki); Kiryukhin, D.P.; Zanin, A.M.;

Barkalov, I.M. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.
Short note; 5 refs.

42858 (INIS-SU–104/A, pp. 21-22) **Low-temperature reactions of methyl radicals in solid Xe.** Grigor'ev, E.I. (Nauchno-Issledovatel'skij Fiziko-Khimicheskij Inst., Moscow (USSR)); Zhukov, D.O.; Trakhtenberg, L.I. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.
Short note; 6 refs.

42859 (INIS-SU–104/A, pp. 38-39) **Effect of radiothermoluminescence on spatial distribution of charged particles during polymer radiolysis.** Shelukhov, I.P. (Nauchno-Issledovatel'skij Fiziko-Khimicheskij Inst., Moscow (USSR)); Zhdanov, G.S.; Klinshpont, Eh.R.; Milinchuk, V.K.; Degtyarev, E.N.; Smirnov, A.I.; Yakimchenko, O.E.; Lebedev, Ya.S. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.
Short note; 3 refs.

42860 (INIS-SU–104/A, pp. 41) **Isotope effects in low-temperature radiation chemical reactions in polyethylene.** Fel'dman, V.I. (Nauchno-Issledovatel'skij Fiziko-Khimicheskij Inst., Moscow (USSR)); Borzov, S.M.; Sukhov, F.F.; Slovokhotova, N.A. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.
Short note; 2 refs.

42861 (INIS-SU–104/A, pp. 64) **Investigation of low-temperature reactions of intermediate charged particles in polystyrene by spectral-luminescent method.** Taraban, V.B. (Nauchno-Issledovatel'skij Fiziko-Khimicheskij Inst., Moscow (USSR)); Shelukhov, I.P.; Zhdanov, G.S.; Klinshpont, Eh.R.; Milinchuk, V.K. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.
Short Communication

42862 (INIS-SU–104/A, pp. 75) **Formation mechanism of allyl radicals during polyethylene low-temperature radiolysis.** Borzov, S.M. (Nauchno-Issledovatel'skij Fiziko-Khimicheskij Inst., Moscow (USSR)); Fel'tsman, V.I.; Sukhov, F.F.; Slovokhotova, N.A. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.
Short note; 2 refs.

42863 (INIS-SU–104/A, pp. 76-77) **Regularities of radiation-chemical decomposition of energy-producing substances at low temperature.** Ryabykh, S.M. (Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR)). Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.
Short note; 1 tab.

42864 (INIS-SU–104/A, pp. 88-89) **Low-temperature radical reactions in polyethylene of different morphology irradiated at 10-20 K.** Fel'dman, V.I. (Nauchno-Issledovatel'skij Fiziko-Khimicheskij Inst., Moscow (USSR)); Borzov, S.M.; Sukhov, F.F.; Slovokhotova, N.A. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.
Short note; 4 refs.

42865 (INIS-SU–104/A, pp. 90) **Low-temperature radiation-induced oxidation of aromatic amines in polymers in the presence of CBr_4.** Kolninov, O.V. (Nauchno-Issledovatel'skij Fiziko-Khimicheskij Inst., Moscow (USSR)); Vinitskaya, I.A.; Milinchuk, V.K. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.
Short Communication

42866 (INIS-SU–104/A, pp. 91-92) **Effect of high pressure on stabilization and reactions of charged particles during polytetrafluorethylene low-temperature radiolysis.** Astakhov, E.Yu. (Nauchno-Issledovatel'skij Fiziko-Khimicheskij Inst., Moscow (USSR)); Klinshpont, Eh.R.; Milinchuk, V.K. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.
Short note; 2 refs.

42867 (INIS-SU–104/A, pp. 93-94) **Low-temperature radiation-chemical reactions of active intermediates with gases dissolved in polytetrafluorethylene.** Astakhov, E.Yu. (Nauchno-Issledovatel'skij Fiziko-Khimicheskij Inst., Moscow (USSR)); Klinshpont, Eh.R. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.
Short note; 2 refs.; 1 tab.

42868 (INIS-SU–104/A, pp. 95-96) **Reactions of alkyl macroradicals in polystyrene and its methyl-substituted at low temperature.** Taraban, V.B. (Nauchno-Issledovatel'skij Fiziko-Khimicheskij Inst., Moscow (USSR)); Voronkina, N.I.; Klinshpont, Eh.R.; Milinchuk, V.K. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.

Short note; 3 refs.; 2 tabs.

42869 (PNL–6500-Pt.4, pp. 27-28) **Differential cross sections for ionization of water by fast electrons.** Miller, J.H.; Manson, S.T. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

Comparisons were made of experimental cross sections for ionization of water molecules by fast electrons (Bolorizadeh and Rudd 1986) and calculations based on a semi-empirical model. The following two exceptions to the general agreement between theory and experiment were noted: (1) experimental cross sections for production of electrons in the final state with energy roughly half of the initial electron energy, where the differential ionization cross section is smallest, were 3 to 5 times larger than calculated results; (2) the model predicted results more than an order of magnitude larger than were observed experimentally for electrons in the final state with energy nearly equal to the initial electron energy.

42870 Growth of silver halides from the molecule to the crystal. Pulse radiolysis study. Schmidt, K.H. (Argonne National Lab., IL (USA)); Patel, R.; Meisel, D. *Journal of the American Chemical Society (USA),* 110(15): 4882-4884 (20 Jul 1988). DOE Contract W-31-109-ENG-38.

Halide ions were produced in situ by pulse radiolysis, via electron transfer to dihalomethanes from solvated electrons or hydrogen atoms, and were then used to generate silver halide molecules and larger aggregates. This evolution of silver halide aggregates was studied for the case of silver iodide on the time scale of 10^{-6}-10^{2} s. Conductivity detection allows determination of the rate of formation of the first AgI molecule. Spectrophotometric detection of the growth of the particles from the stage of the molecular species to colloidal particles of bulk electronic properties is then possible. When the aggregates thus formed approach sizes of ca. 50° Å, their detection by light scattering provides an independent method of size determination. In the region where such measurements are possible, the sizes determined by light scattering agree with sizes calculated assuming confinement excitons in small particles and their electron-hole coulomb screening. A similar approach is suggested for growth studies of other insoluble materials. 13 references, 3 figures.

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Refer also to citation(s) 42015, 42724, 43202, 43209, 43441, 44316, 44318, 44319, 44329, 44330, 44331

42871 (GSI–89-37(prepr.)) **Chemical properties of element 105 in aqueous solutions: Halide complex formation and anion exchange into triisoctyl amine.** Kratz, J.V.; Zimmermann, H.P.; Scherer, U.W.; Schaedel, M.; Bruechle, W.; Gregorich, K.E.; Gannett, C.M.; Hall, H.L.; Henderson, R.A.; Lee, D.M. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.). Apr 1989. 38p. Order Number DE89795715/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Studies of the halide complexation of element 105 in aqueous solution were performed on 34-s ^{262}Ha produced in the ^{249}Bk (^{18}O, 5n) reaction. The ^{262}Ha was detected by measuring the fission and alpha activities associated with its decay and the alpha decays of its daugther, 4.3-s ^{258}Lr. Time-correlated pairs of parent and daughter alpha particles provided a unique identification of the presence of ^{262}Ha. About 1600 anion exchange separations of ^{262}Ha from HCl and mixed HCl/HF solutions were performed on a one-minute time scale. Reversed-phase micro-chromatographic columns incorporating triisooctyl amine (TIOA) on an inert support were used in the computer-controlled liquid chromatography apparatus, ARCA II. ^{262}Ha was shown to be adsorbed on the column from either 12 M HCl/0.02 M HF or 10 M HCl solutions like its homologs Nb and Ta, and like Pa. In elutions with 4 M HCl/0.02 M HF (Pa-Nb fraction), and with 6 M HNO_3/0.015 M HF (Ta fraction), the ^{262}Ha activity was found in the Pa-Nb fraction showing that the anionic halide complexes are different from those of Ta, and are more like those of Nb and Pa. In separate elutions with 10 M HCl/0.025 M HF (Pa fraction) and 6 M HNO_3/0.015 M HF (stripping of Nb) the ^{262}Ha was found to be equally divided between the Pa and Nb fractions. The non-tantalum like halide complexation of Ha is indicative of the formation of oxohalide complexes, like $[NbOCl_5]^{2-}$ and $[PaOCl_5]^{2-}$, in contrast to the pure halide complexes in Ta, like $[TaCl_7]^{2-}$. (orig.).

42872 (GSI–89-38(prepr.)) **ARCA II - a new apparatus for fast, repetitive HPLC separations.** Schaedel, M.; Bruechle, W.; Jaeger, E.; Schimpf, E.; Kratz, J.V.; Scherer, U.W.; Zimmermann, H.P. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.). Apr 1989. 18p. Order Number DE89795716/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The microcomputer controlled Automated Rapid Chemistry Apparatus, ARCA, is described in its newly designed version for the study of chemical properties of element 105 in aqueous solutions. This improved version, ARCA II, is adapted to the needs of fast and repetitive separations to be carried out in a chemically inert automated micro high performance liquid chromatography system. As an example, the separation of several group IIIB, IVB, and VB elements in the system triisooctylamine/hydrochloric acid within 30 s is demonstrated. Furthermore, a new method for the fast preparation of samples for α-particle spectroscopy by evaporation of the aqueous effluent with an intense light source is presented. (orig.).

42873 (INIS-mf–11989, pp. 223) **Analytical studies of chemical and physical properties of concentrated plutonium solutions in nitric acid medium and their variations during long time storage.** Cuillerdier, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)); Cossonnet, C.; Peiras, M. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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42874 (INIS-SU–97, pp. 99) **Basicity determination for neutral phosphorus organic extragents by NMR ^{31}P-method in two-phase systems, and quantitative interrelations of acido-basic extractive properties.** Laskorin, B.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR)); Yakshin, V.V.; Meshcheryakov, N.M.; Yagodin, V.G. AN SSSR, Moscow (USSR). 1988. (CONF-8807136–: ISEC '88: international solvent extraction conference, Moscow (USSR), 18-24 Jul 1988). In *International solvent extraction conference. Vol. 1. Conference papers.* Order Number DE89012151/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Consideration is given to the method for determination of basicity of neutral organophosphorus compounds of XGZP=0 type (X, G, Z=C_4H_9, C_8H_{17}, C_6H_5). The method is based on change of chemical shift of phosphorus-31 nuclei in two-phase extraction system depending on acidity function H_O, H_A, H_{PO}. It is shown that the method can be used for evaluation and forecasting of phosphine oxide ability in the processes of UO_2SO_4 solvent extraction from aqueous solutions of sulfuric acid.

42875 (INIS-SU–97, pp. 241-243) **Microviscosity of ions and salting-out in the extraction of rare earth and transplutonium elements.** Gorskij, B. (Joint Inst. for Nuclear Research, Dubna (USSR)); Gorskij, N.; Winde, Ch. AN SSSR, Moscow (USSR). 1988. (CONF-8807136–: ISEC '88: international solvent extraction conference, Moscow (USSR), 18-24 Jul 1988). In *International solvent extraction conference. Vol. 1. Conference papers.* Order Number DE89012151/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Consideration is being given to possibility of theoretical explanation of experimental data, obtained when studying solvent extraction of rare earth (REE) and transplutonium (TPE) elements by the mixture TOPO-DTPA-lactic acid (where TOPO-trioctylphosphine oxide, DTPA-diethylenetriaminopentaacetic acid) and aliquat 336 in the presence of various salting-out agents. Dependences of separation coefficients on microviscosity of salting-out cations (Al^{3+}, Mg^{2+}, Cu^{2+}, Co^{2+}, Zn^{2+}, Ni^{2+}, Cd^{2+}, Pb^{2+}) (ν_1) in extractive systems: HNO_3-TOPO/benzene and DTPA-lactic acid-TOPO/benzene - are presented. It is shown that efficiency of salting-out agents increases with microviscosity growth. Dependences of coefficients of Ce^{3+} and

Eu^{3+} extractive separation using aliquat 336 on ν_1 are given. 5 refs.; 3 figs.; 2 tabs.

42876 (INIS-SU–97, pp. 248-251) **Mechanism study on extraction uranium (6) from mixed aqueous-organic media with TOA.** Shi Xiukun (Beijing Univ., BJ (China). Dept. of Technical Physics); Shen Xinghai; Peng Qixiu; Gao Hongcheng. AN SSSR, Moscow (USSR). 1988. (CONF-8807136–: ISEC '88: international solvent extraction conference, Moscow (USSR), 18-24 Jul 1988). In *International solvent extraction conference. Vol. 1. Conference papers.* Order Number DE89012151/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

A study was made on change of uranium distribution coefficient in uranyl sulfate extraction by trioctylamine (TOA) with the addition of different organic solvents, mixing with water, into the equeous phase. Influence of dielectric constant of polar phase, solvent polarity, interphase tension on distribution coefficient was considered. It is shown that the mechanism of uranyl sulfate solvent extraction by TOA in the polar phase is the same as in the absence of organic solvents; the latters don't enter the composition of extracted complex at that. 1 ref.; 4 figs.

42877 (INIS-SU–104/A, pp. 177) **Low-temperature chemiluminescence.** Lotnik, S.V. (AN SSSR, Ufa (USSR). Inst. Khimii); Kazakov, V.P. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.

Short Communication

42878 (INIS-SU–104/A, pp. 178) **Chemiluminescence and tau-metry of phase transition effect on rate of uranium (4) low-temperature oxidation with xenon difluoride in frozen solutions of H_2SO_4, D_2SO_4 and their mixtures.** Lotnik, S.V. (AN SSSR, Ufa (USSR). Inst. Khimii); Kalinina, V.M.; Kazakov, V.P. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.

Short Communication

42879 (INIS-SU–104/A, pp. 215-216) **Synthesis and physicochemical properties of binuclear complex pentakistrifluorophosphinetechnetium (0).** Babichev, A.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii); Klimov, V.D.; Mamchenko, A.V. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, Moscow (USSR), 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.

Short note; 2 refs.; 1 tab.

42880 (ORNL/M–500, pp. 1-10) **Chemistry of actinides and fission products.** Pruett, D.J.; Sherrow, S.A.; Toth, L.M. Oak Ridge National Lab., TN (USA). 1988. In *Research programs for Division of Chemical Sciences, Office of Basic Energy Sciences, Department of Energy.* Order Number DE89003693/JAW. Available from NTIS, PC A03/MF A01.

This task is concerned primarily with the fundamental chemistry of the actinide and fission product elements. Special efforts are made to develop research programs in collaboration with researchers at universities and in industry who have need of national laboratory facilities. Specific areas currently under investigation include: (1) spectroscopy and photochemistry of actinides in low-temperature matrices; (2) small-angle scattering studies of hydrous actinide and fission product polymers in aqueous and nonaqueous solvents; (3) kinetic and thermodynamic studies of complexation reactions in aqueous and nonaqueous solutions; and (4) the development of inorganic ion exchange materials for actinide and lanthanide separations. Recent results from work in these areas are summarized here.

42881 (RCM–01788) **Complexation of americium with humic acid. Contribution to the interlaboratory comparison exercise of the 'COCO-Club' in the CEC project MIRAGE II, Pt. 2: Complexation.** Kim, J.I.; Buckau, G.; Klenze, R. Technische Univ. Muenchen, Garching (Germany, F.R.). Inst. fuer Radiochemie. Jan 1989. 35p. Contract FI 1W-0067-D(B). Order Number DE89795973/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

As a part of the interlaboratory comparison exercise for the complexation of humic acid and colloid generation (COCO-Club activities) in the CEC project MIRAGE-II, the complexation of americium with humic acid has been studied in our laboratory. Two humic acids were used for the study: Aldrich-HA(H^+) which is a reference humic acid of the COCO-Club and Bradford-HA(H^+) from Lake Bradford, Florida. A wide concentration range of humic acid and different ratios of Am to humic acid have been investigated between pH 5 and 6 with the ionic strength of 0.1 M and 1.0 M. The complexation has been studied by UV-spectroscopy, Laser-induced Photoacoustic Spectroscopy (LPAS) and ultrafiltration. LPAS is used for the submicromolar concentration range where the sensitivity of UV spectroscopy is not accessible. Ultrafiltration is used for low Am to humic acid ratios where both spectroscopic methods are not applicable. Varying the humic acid concentration over three orders of magnitude, only a 1:1 type of binding is observed. No significant variation of the stability constant is found in the investigated range of pH and ionic strength. However, the precipitation tendency and the loading capacity of humic acid are found to depend sensitively on pH and ionic strength. The complexation study provides a deep insight into the influence of humic acid on the migration behaviour of fission products and actinides in the geosphere. (orig.).

42882 NMR studies of aging effects in palladium tritide. Abell, G.C. (9515000); Attalla, A. *Fusion Technology (USA),* 14(2): 643-648 (Sep 1988). (CONF-880505–: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

This paper presents Nuclear Magnetic Resonance (NMR) studies of aging phenomena in palladium tritide. ^3He NMR relaxation parameters have been measured as a function of temperature for 6-, 13-, and 22-month-old beta phase palladium tritide. The most significant result of this study is the observation of a solid/fluid phase transition near 250 K of ^3He that has accumulated in the PdT_x substrate via triton decay. Although the existence of solid helium at relatively high temperatures had been predicted for helium in metals, it had not previously been confirmed in any metal/helium system. The observed melting temperatures, together with the known equation of state for ^4He, allow a determination of the helium density as a function of age. The atomic density obtained in this way is approximately 2.0 times that of palladium metal, agreeing with densities inferred from dilatometric measurements of other metal tritides and also with predictions based on the concept of dislocation loop punching by highly overpressurized He bubbles. The ^3He signal in the 22-month-old sample was sufficiently strong to allow a detailed study of melting as a function of temperature, and provides information on the distribution of densities over the ensemble of bubbles.

42883 Electron-transfer reactions of uranium(V): kinetics of the uranium(V)-uranium(VI) self-exchange reaction. Howes, K.R. (Iowa State Univ., Ames (USA)); Bakac, A.; Espenson, J.H. *Inorganic Chemistry (USA),* 27(5): 791-794 (9 Mar 1988). DOE Contract W-7405-ENG-82.

Uranium(V) has been prepared photochemically; its uv spectrum shows a peak at 255 nm with an extinction coefficient of 660 L mol^{-1} cm^{-1}. Conventional uv/visible, stopped flow, and laser flash photolysis techniques have been used to study the electron-transfer reactions of uranium(V) and uranium(VI) with a range of chromium, ruthenium, and cobalt complexes. Application of Marcus theory to these results suggest a uranium(VI)/uranium(V) self-exchange rate constant in the range 1-15 L $mol^{-1}s^{-1}$. Some of the cross-reactions appear to be nonadiabatic, and these are slower than predicted. 20 references, 4 figures, 4 tables.

42884 Infrared analysis of liquid and solid D-T. Souers, P.C. (9513035); Fearon, E.M.; Stump, R.K.; Tsugawa, R.T. *Fusion Technology (USA),* 14(2): 850-854 (Sep 1988). (CONF-880505–: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

Collision-induced infrared spectroscopy may be used to measure the composition of a liquid or solid deuterium-tritium (D-T) mixture. For T_2, DT and D_2, respectively, the authors measure the areas under the absorption peaks in the regions 76.75 to 80.19, 85.29 to 88.74, and 92.79 to 96.23 THz (2560 - 2675, 2845 - 2960 and 3095 - 3210 cm^{-1}). These areas are multiplied, respectively, by these isotopic sensitivities derived from quantum calculations: 1.000, 0.891, and 0.811. The resulting numbers are proportional to the molar composition. Nearly equimolar D-T samples show good agreement between mass and infrared spectroscopy. The large DT peak in enriched molecular DT overemphasizes D_2 in the infrared analysis, but these results may be corrected with the room-temperature, mass-spectroscopic D-to-T ratio.

42885 Tritium labeling of amino acids and peptides with liquid and solid tritium. Peng, C.T. (9524310); Hua, R.L.; Souers, P.C.; Coronado, P.R. *Fusion Technology (USA),* 14(2): 833-839 (Sep 1988). (CONF-880505–: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

Amino acids and peptides were labeled with liquid and solid tritium at 21 K and 9 K. At these low temperatures radiation degradation is minimal, and tritium incorporation increases with tritium concentration and exposure time. Ring saturation in L-phenylalanine does not occur. Peptide linkage in oligopeptides is stable toward tritium. Deiodination in 3-iodotyrosine and 3,5-diiodotyrosine occurs readily and proceeds in steps by losing one iodine atom at a time. Nickel and noble metal supported catalysts when sued as supports for dispersion of the substrate promote tritium labeling at 21 K. The authors study shows that both liquid and solid tritium are potentially useful agents for labeling peptides and proteins.

42886 Applications of high resolution ^3H NMR spectroscopy. Williams, P.G. (9513035). *Fusion Technology (USA),* 14(2): 840-844 (Sep 1988). (CONF-880505–: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

High resolution tritium NMR spectroscopy is a neglected technique. Although it may be performed on almost any modern NMR spectrometer, there are only a handful of sites actively using this method for analysis of their tritiated materials. The utility of the technique has been demonstrated in many applications, including: catalysis and hydrogen isotope exchange; elucidation of biosynthetic pathways; studies of metabolism; and measurement of the optical and radiochemical purity of radiopharmaceuticals. Several of these applications are illustrated here, along with some advantages of modern NMR techniques.

42887 Kinetics of neptunium(VI) reduction by Kojic acid. Kim, W.H. (Florida State Univ., Tallahassee (USA)); Choppin, G.R. *Inorganic Chemistry (USA),* 27(16): 2771-2773 (10 Aug 1988).

The kinetics for Np(VI) reduction by kojic acid, HK, have been studied at tracer level concentrations of Np(VI) in aqueous chloride media. The empirical rate expression for the reaction was found to be $-d[Np(VI)]/dt = k[Np(VI)][HK]_T/[H^+]$, where T denotes the total concentration. Rate constant and activation parameters have been determined at an ionic strength of 1.0 M (NaCl) and 25.0°C to be $k = 1.63 \pm 0.08\ s^{-1}$, $\Delta H‡ = 82.7 \pm 3.4$ kJ/mol, and $\Delta S‡ = 34 \pm 12$ J/(mol·K). The rate decreases with increasing ionic strength. A reaction mechanism is discussed. 26 references, 3 figures, 3 tables.

42888 Kinetics of electron-transfer reactions between transition-metal complexes and the methyl viologen radical cation. Howes, K.R. (Argonne National Lab., IL (USA)); Pippin, C.G.; Sullivan, J.C.; Meisel, D.; Espenson, J.H.; Bakac, A. *Inorganic Chemistry (USA),* 27(17): 2932-2934 (24 Aug 1988).

Kinetic data for the reactions between $MV^{+\cdot}$ and eight transition-metal complexes (of cobalt, ruthenium, chromium, and iron) and the uranyl ion were determined at pH 4 in 0.1 M perchlorate medium by pulse radiolysis. All the oxidants investigated are outer-sphere reagents with known standard reduction potentials and self-exchange rate constants. The measured rate constants are in agreement with those predicted by the Marcus theory after allowances are made for the diffusion control and electrostatics. 21 references, 2 figures, 1 table.

42889 Analysis of the $5f^1 \rightarrow 6d^1$ transitions in PaX_6^{2-} (X = Cl, $Br_,$) and $Pa^{4+}/ThBr_4$. Edelstein, N. (Lawrence Berkeley Lab., CA (USA)); Krupa, J.C.; Naik, R.C.; Rajnak, K.; Whittaker, B.; Brown, D. *Inorganic Chemistry (USA),* 27(18): 3186-3189 (7 Sep 1988). DOE Contract AC03-76SF00098.

The optical spectra of $Pa^{4+}/ThBr_4$ and M_2PaX_6 (M = Cs, X = Cl; M = NEt_4, X = Cl, Br) in the visible and ultraviolet ranges have been obtained and are analyzed in terms of a Hamiltonian including the crystal field and spin-orbit interactions for the 6d configuration. A lower limit of $\approx 13{,}800\ cm^{-1}$ is obtained for the total crystal field splitting of PaX_6^{2-}. Spin-orbit coupling constants of $\zeta_{6d} = 2050\ cm^{-1}$ (PaX_6^{2-}) and $\zeta_{6d} = 1570\ cm^{-1}$ ($Pa^{4+}/ThBr_4$) are obtained. Relative shifts of 5f-6d configuration centroids in crystals are compared to the free-ion values. 14 references, 4 figures, 5 tables.

4008 Combustion, Pyrolysis, and High-temperature Chemistry

Refer also to citation(s) 42420, 42772, 43303

42890 (AD-A–205373/4/XAB) **Determination of combustion gas temperatures by infrared radiometry in sooting and non-sooting flames. Technical paper.** Lyons, V.J.; Gracia-Salcedo, C.M. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Feb 1989. 13p. (NASA-E–4446). Available from NTIS, PC A03/MF A01.

Flame temperatures in nonsooting and sooting environments were successfully measured by radiometry for premixed propane/oxygen laminar flames stabilized on a water-cooled, porous sintered bronze burner. The measured temperatures in the nonsooting flames were compared with fine-wire thermocouple measurements. The results show excellent agreement below 1700 K, and when the thermocouple measurements were corrected for radiation effects, the agreement was good for even higher temperatures. The benefits of radiometry are (1) the flow is not disturbed by an intruding probe, (2) calibration is easily done using a blackbody source, and (3) measurements can be made even with soot present. The theory involved in the radiometry measurements is discussed, as well as the energy balance calculations used to correct the thermocouple temperature measurements.

42891 (AD-A–206041/6/XAB) **Calibration of nondestructive birefringence fuel thermal deposit rating device. Final report, September 1987-March 1988.** Barbee, J.G.; Stavinoha, L.L. Southwest Research Inst., San Antonio, TX (USA). Fuels and Lubricants Research Div. Aug 1988. 47p. (SWRI–17-7958-842). Available from NTIS, PC A03/MF A01.

This documents the results of SwRI comparison of techniques for measuring the thickness of deposits formed on the surface of heated metal tubes during JFTOT testing of fuels. The techniques evaluated in this program included optical birefringence, dielectric strength, and ion milling. A fourth method involving cross sectioning and direct measurement of deposit thickness at high magnification using electron microscopy would serve as referee if wide disagreement among the three primary techniques was encountered. Considering the inherent difficulties in measuring deposits of less than 1 micrometer by any indirect approach, all three methods showed surprisingly good agreement when the data were plotted for comparison.

42892 (AD-A–206101/8/XAB) **Novel organoboranes as intermediates for ceramic precursors and high-energy fuels. Final technical report, 1 February 1985-31 August 1988.** Eisch, J.J. State Univ. of New York, Binghamton, NY (USA). Dept. of Chemistry. 1 Jan 1989. 27p. Available from NTIS, PC A03/MF A01.

This project investigated, as its primary objective, the influence of carbon-boron bonding in unsaturated, cyclic boranes on the energy content of this system. Such insights should aid the choice of the best carbon-boron clusters to be incorporated into high-energy fuels. The synthesis and structural characterization of the following boron-containing carbocycles were undertaken: The borirene or boracyclopropene system, as exemplified by trimesitylborirene: the

borole or boracyclopentadiene ring, as represented by pentaarylboroles: the borepin or boracycloheptatriene nucleus, as seen in heptaphenylborepin; the 7-borabicyclo 2.2.1 heptadiene system, again typified by its heptararyl derivative; and the 1-boratetrahydronaphthalene derivative, which was the thermal rearrangement product of the borepin. As estimated by chemical reactivity towards heat, oxidants and protolyzing agents, the borirene and borole nuclei display unusual stability and thus can be termed aromatic. The boroles are very reactive and possess destabilization or be antiaromatic. A rich variety of both thermal and photochemical skeletal rearrangements was uncovered with these boracyclopolyenes, indicating that tricoordinate boron has a pronounced tendency to interact either intermolecularily or intramolecularily, with pi-electrons. As a secondary objective, bimetallic oxides of the type, R2M-O-M'R2, were synthesized and evaluated as hydrocarbon-soluble precursors to specialized ceramics.

42893 (AD-A–206238/8/XAB) **Optical measurements of soot particles in flames.** Santoro, R.J. Pennsylvania State Univ., University Park, PA (USA). Dept. of Mechanical Engineering. 1988. 8p. Available from NTIS, PC A02/MF A01.

The formation and growth of soot particles in combustion systems represents an area of significant research interest. Critical to progress in this area has been development of suitable optical diagnostic techniques. Principal among this has been the utilization of laser light scattering techniques to obtain particle size and concentration information. When combined with measurements of other quantities such as the velocity, the resulting spatially and temporally resolved measurements can be used to examine particle processes such as coagulation and surface growth. In the present work, the results from studies conducted in laminar diffusion flames involving laser based measurements of the soot particle and velocity fields are reviewed. As an example of the utility of such an approach, these results are used to examine the evolution of the particle surface area for a series of simple hydrocarbon fuels. The results indicate that the available surface area varies strongly with the fuel molecular structure. However, the specific surface growth rate is observed to be similar for all the fuels studied.

42894 (AD-A–206693/4/XAB) **Computer modeling of soot formation comparing free radical and ionic mechanisms. Annual report, 1 October 1987-30 September 1988.** Calcote, H.F.; Gill, R.J. AeroChem Research Labs., Princeton, NJ (USA). Mar 1989. 41p. (AEROCHEM-TP–482). Available from NTIS, PC A03/MF A01.

A collaborative effort was initiated between AeroChem and Penn State to compare the relative importance of the free radical mechanism of Frenklach and associates and the ionic mechanism of Calcote and associates by use of a computer program run at Penn State. During the present report period: the thermodynamic data for some neutral species and the ions employed in the ionic mechanism were either compiled from the literature or calculated; the reaction mechanism was developed and the rate coefficients either obtained from the literature or estimated; and the ambipolar diffusion coefficients of the ions involved were calculated. Considerably more work is yet required in estimating the reaction rate coefficients. Comparative computer runs will first be made on the well documented sooting acetylene/oxygen/argon flat flame at a pressure of 1.67 kPa and a linear flow rate of 50 cm/s.

42895 (AD-A–206839/3/XAB) **Fuel structure and pressure effects on the formation of soot particles in diffusion flames. Annual technical report, 15 January 1988-15 January 1989.** Santoro, R.J. Pennsylvania State Univ., University Park, PA (USA). Dept. of Mechanical Engineering. 15 Feb 1989. 41p. Available from NTIS, PC A03/MF A01.

Original contains color plates: All DTIC/NTIS reproductions will be in black and white.

Studies emphasizing the effects of fuel molecular structure on soot formation processes in laminar-diffusion flames were investigated. Particular attention was given to the particle inception and surface growth processes for a series of fuels. Studies of butane, 1-butene, and 1,3 butadiene have revealed that fuel structure strongly affects the soot-particle-inception process. However, subsequent surface-growth processes are largely determined by the available surface area. Thus, the surface growth process is independent of the fuel molecular structure following the initial particle-inception stage. Studies of the particle-inception region indicate that increased soot formation is strongly correlated with visible-fluorescence measurements attributed to large polynuclear aromatic hydrocarbon species in the flame.

42896 (AD-A–207003/5/XAB) **Asynchronous optical sampling for laser-based combustion diagnostics in high-pressure flames. Final report, 15 December 1988-31 January 1989.** King, G.B.; Laurendeau, N.M.; Lytle, F.E. Purdue Univ., Lafayette, IN (USA). Dept. of Chemistry. 28 Feb 1989. 21p. Available from NTIS, PC A03/MF A01.

This report describes progress on the development of a new laser-based combustion diagnostic for the quantitative measurement of both major and minor species in high pressure flames. The technique, Asynchronous Optical Sampling (ASOPS), is a state-of-the-art improvement in picosecond pump/probe spectroscopy. The timing parameters for the current ASOPS instrument are described and consideration is given to the optimization of these parameters. Results from the study of the sodium atom in an atmospheric flame are presented. Instrumental changes are shown that considerably improve the ASOPS signal-to-noise ratio. A technique for optimization of ultra-violet generation is demonstrated and initial hydroxyl fluorescence experiments are described.

42897 (EMR/ER–87-60(TR)) **Report on workshop on fluidized bed combustion in Canada.** Anthony, E.J.; Grace, J.R. Canada Centre for Mineral and Energy Technology, Ottawa, ON (Canada). Energy Research Labs. 1987. 41p. (MICROLOG–87-06442). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

A one day workshop on fluidized bed combustion (FBC) was organized at the University of British Columbia (UBC) in 1987. Sixteen speakers from across Canada spoke on various aspects of FBC technology; three site visits were also conducted to the UBC pilot plant circulating FBC unit, the cold model circulating FBC facility, and the spout-fluid bed combustor and high pressure gasifier at B.C. Research. The audience included representatives from a number of the major petrochemical and engineering consulting companies and Canadian universities. This report provides a permanent record of the event including a short summary of the presentations, together with a list of papers prepared for, or distributed at, the workshop. Summaries are presented of papers on hydrodynamics and gas mining, heat transfer, solids mixing design and operation of circulatory FBC units, NO_x and SO_2 emissions, Syncrude Coke combustion, effect of coal type on combustion, hot gas cleaning, tube erosion, waste characterization and disposal, mathematical models, environmental aspects, and research program activities. 22 refs., 12 figs., 1 tab.

42898 (PB–89-179337/XAB) **Infrared multiphoton ignition and enhancement of combustion. Final report.** Lavid, M.; Poulos, A.T. M.L. Energia, Inc., Princeton, NJ (USA). Aug 1986. 41p. Available from NTIS, PC A03/MF A01.

The research demonstrated the feasibility of obtaining reliable ignition and enhancement of combustion by a novel concept, Infrared Multiphoton Absorption/Dissociation (IRMPA/IRMPD). A methanol-oxygen system was chosen to test this concept because methanol is a potential alternative fuel susceptible to IRMPD. Multiphoton absorption, dissociation, and ignition experiments were conducted in closed pyrex reaction cells with IR-transmitting NaCl windows. Various pressures of pure methanol and methanol-oxygen mixtures were irradiated with single pulses from a TEA CO_2 laser usually tuned at 10.33 micrometers and focused to fluences in the range 1-80 J/cm2. Temporal and spatial ignition behaviors were investigated and successful ignitions were obtained by multiphoton absorption processes. The research scope was expanded to include a second alcohol, 2-propanol.

42899 (PB–89-189187/XAB) **Effect of water on piloted ignition of cellulosic materials. Annual progress report. Doctoral thesis.** Abu-Zaid, M.; Atreya, A. Michigan State Univ., East Lansing, MI (USA). Dept. of Mechanical Engineering. Feb 1989. 187p. Available from NTIS, PC A09/MF A01.

See also PB–87-127732.

This experimental study is an attempt to quantify the effect of water on extinguishment, thermal decomposition, and piloted ignition of wood. In the extinguishment part, cooling of hot porous and non-porous ceramic solids by water droplets was studied. These solids were used to simulate low thermal diffusivity porous and non-porous combustible building materials and were instrumented by several surface and in-depth thermocouples. Temperature measurements in the solid were used to quantify the heat transfer during droplet evaporation. Thermal decomposition of wood in air was also studied as a function of sample moisture content and externally applied radiation prior to the ignition experiments. Simultaneous measurements of weight loss rate; surface, bottom and in-depth temperatures; O2 depletion and production of CO2, CO, total hydrocarbons and water were made. It was found that the presence of moisture delayed the decomposition process and diluted the decomposition products. Piloted ignition experiments were conducted on Douglas fir for four different moisture contents and at different levels of externally applied radiation. It was found that the presence of moisture increases the ignition time, surface temperature and the evolved mass flux at ignition. A single equation was derived to correlate all the ignition data. This correlation accounts for the moisture dependent thermal properties and the heat loss from the sample surface.

42900 Dynamics of nearly extinguished nonadiabatic premixed flames in a gravitational field. Kaper, H.G. (9502076); Leaf, G.K.; Matkowsky, B.J.; Olmstead, W.E. *SIAM Journal on Applied Mathematics (USA)*, 48(5): 1054-1063 (Oct 1988).

A nonlinear stability analysis of a uniformly propagating plane flame subject to gravitational forces and small volumetric heat loss is presented. A nonlinear partial differential equation describing the evolution and structure of the flame near the extinction point (i.e., the point beyond which a uniformly propagating plane flame cannot be sustained) is derived. It is shown that this equation admits nontrivial solutions beyond the extinction point. The solutions represent steady wrinkled flames, which are spatially periodic in the direction transverse to the direction of propagation of the flame.

42 ENGINEERING

Refer also to citation(s) 42242

4202 Facilities and Equipment

Refer also to citation(s) 41479, 41685, 41751, 41752, 41753, 41754, 41769, 41936, 41963, 42012, 42152, 42153, 42154, 42448, 42492, 42494, 42608, 43051, 43052, 43696, 44263, 44264, 44265, 44266, 44268, 44269, 44270, 44271, 44272, 44273, 44274, 44275, 44276, 44277, 44278, 44279, 44280, 44281, 44293, 44372

42901 (AD-A-205452/6/XAB) **Long pulse homopolar generator. Final report, April 1983-June 1987.** Knoth, E.A.; Bauer, D.P. IAP Research, Inc., Dayton, OH (USA). Aug 1988. 29p. Available from NTIS, PC A03/MF A01.

The objective of this program was to develop a lightweight, long-pulse homopolar generator. The generator is designed to deliver 250 kW at 10kA for pulses greater than 10 seconds. This report reviews the truncated drum (rotor) design and the testing performed. The main design features, such as active excitation-coil cooling, of the generator components are reviewed.

42902 (AD-A-205469/0/XAB) **Coherence and chaos phenomena in josephson oscillators for superconducting electronics. Final report, 21 May 1988-21 January 1989.** Christiansen, P.L.; Paramentier, R.D.; Skovgaard, O. Technical Univ. of Denmark, Lyngby (Denmark). Lab. of Applied Mathematical Physics. 25 Jan 1989. 235p. Available from NTIS, PC A11/MF A01.

Work under the present contract has been dedicated to acquiring a detailed understanding of the fundamental mechanisms governing the dynamics of Josephson junction devices, with a view to employing this knowledge in the design of practical Josephson-devices. Particular attention has been given to the questions of the interplay between coherence and chaos, and to determining the limits of stability of coherent states. A combination of analytical, computational, and experimental methods has been employed in order to maximize the results obtained.

42903 (AD-A-206092/9/XAB) **Parametric study of radiative cooling of solid antihydrogen. Master's thesis.** MacLachlan, M.J. Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering. Mar 1989. 56p. (AFIT/GNE/ENP-89M-4). Available from NTIS, PC A04/MF A01.

A computer model of cryogenic system for storing solid antimatter is used to explore the radiative cooling-power requirements for long-term antimatter storage. If vacuum-chamber pressures as low as 10 to -18th power torr can be reached, and the rest of the large set of assumptions is valid, milligram quantities of solid antimatter could be stored indefinitely at 1.5 K using cooling powers of less than a microwatt. Many of the assumptions made are problematic and need verification, as they could potentially change the results greatly. The system modeled is a sphere of solid anti-parahydrogen at 1.5 K or below levitated in a spherical cryogenic vacuum chamber. The free matter gas in the chamber is assumed to be molecular hydrogen, and sublimation of both matter and antimatter is assumed to be negligible. The antihydrogen is assumed to be in thermal equilibrium, although annihilation-energy deposition is localized and hydrogen's thermal-impulse response time is comparable to the interval between annihilations. A parametric analysis is performed, with system cooling power evaluated over a wide range of pressures and system sizes, as temperature and emissivity are also varied. The cooling-power requirements of storing solid antimatter for extended times may not be an obstacle, if the proper conditions are obtained. However, whether these conditions are indeed possible remains in doubt.

42904 (AD-A-206800/5/XAB) **Preparation of the superconductor substrate: strontium titanate. Final report.** Quinlan, K.P.; Hilton, R.M.; Adamski, J.A. Rome Air Development Center, Griffiss AFB, NY (USA). Sep 1988. 18p. (RADC-TR-88-216). Available from NTIS, PC A03/MF A01.

Preparation of the superconductor substrate, strontium titanate, is described. Procedures used to prepare the substrates for the strontium titanate boules are detailed. The strontium titanate crystals are grown using an oxidizing flame (hydrogen to oxygen ratio of (1)). The other parameters used for crystal growth are reported. The growth direction was determined to be 5° away from the (211) direction. ICP-emission spectroscopy indicates that the burner material may contribute a small amount of impurities to the crystals.

42905 (AD-A-207174/4/XAB) **Report on the possible benefits of using high-temperature superconductor materials in particle-accelerator design. Final report, June-September 1987.** Cohen, L.; Collins, R.; Balko, B. Institute for Defense Analyses, Alexandria, VA (USA). Dec 1988. 25p. (IDA-M-444). Available from NTIS, PC A03/MF A01.

This report discusses different design concepts for particle-beam accelerators. It demonstrates that with the use of high-temperature superconducting materials, a more-compact, lighter, and more-robust accelerator design can be realized for the space-based neutral particle beam (NPB) accelerator.

42906 (EGG-M-88359) **Effect of lead shielding on cask pin puncture.** Wells, A.H.; Liu, T.L.; Chuang, C.; Ball, L.W. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 11p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC07-76ID01570. (CONF-890631-66: International symposium on packaging and transporting of radioactive materials, 11-16 Jun 1989). Order Number DE89016194/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

The overall weight of a spent-fuel transport cask is minimized when its gamma shield consists of depleted uranium only; however, because of its high modulus of elasticity, a gamma shield of depleted uranium only, may not meet the 10 CFR 71 puncture requirements. This concern prompted investigation of hybrid gamma shields consisting of an outer layer of lead with an inner layer of depleted uranium; these gamma shield were assumed to be sandwiched between two stainless steel shells. The outer steel shell is permitted to plastically deform during a puncture event; however, if only depleted uranium is present, the puncture forces are transmitted through the depleted uranium and a permanent dimple in the

inner containment shell may result. A shell of lead outside the depleted uranium shell acts as a shock absorber, diffusing the concentrated load of the pin. The purpose of this study was to determine the optimum thickness combination of a multiwall, depleted uranium/lead gamma shield for a spent-fuel transportation cask. 2 refs., 1 fig., 2 tabs.

42907 (EGG-M–88416) **Transporting spent and damaged fuel in the United States: Recent experience and lessons learned related to the evolving transportation policy of the US Department of Energy.** Reno, H.W.; Schmitt, R.C.; Lattin, W.C. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1989]. 7p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-890631–62: International symposium on packaging and transporting of radioactive materials, 11-16 Jun 1989). Order Number DE89016365/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In 1987, Fischer et al. noted that the number of shipments of commercial spent nuclear fuel will increase dramatically in the United States, because such material will be moved from power reactors (most of which are in the East) to a federal repository for high-level radioactive waste (presently being considered in the West). The US Department of Energy, through its Office of Civilian Radioactive Waste Management, is preparing for that large-scale transport effort by developing new cask systems and modifying existing transport policy. Understandably, public attention is focused on issues related to transport of radioactive materials. This paper summarizes experience gained from recent transport actions of the Department of Energy, relates lessons learned therefrom to an evolving policy in the Department, and discusses some aspects of public involvement in such transport activities. 8 refs.

42908 (ENEL-SI–837-87) **Pipeline flow rate measurements: intercomparison tests of current meters and a multipath acoustic flowmeter.** Grego, G. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Sep 1987. 18p. Order Number DE89761887/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

ENEL (Italian National Electricity Board) compared the multipath travel time acoustic flowmeter, AFM, of Ferranti O.R.E. Accusonic Division, with current meters used at the Porto Tolle thermoelectric power plant, Italy. The pipe diameter was 3.2 m and average velocity varied from 1.5 to 3.4 m/s. During the first test, current meters and the AFM were installed respectively 40 and 35 diameters downstream of a 90 degree bend. The difference of the flow rate between the two systems varied from 0.8% at minimum velocity to 0.2% at maximum velocity. During the second test, the current meters were compared with two installations of crossed planes. One was installed upstream of a 90 degree bend and the other was installed immediately downstream. The first gauging section had a straight pipe length of 75 diameters and the second, 1.4 diameters. The current meters gauging section had 79 diameters of straight pipe. Very good agreement resulted not only for the acoustic flowmeter installed upstream of the bend, but also for that installed immediately downstream.

42909 (JAERI-M–89-023) **Study on intelligent nuclear systems, (HASP: human acts simulation program). Progress report 1988.** Asai, Kiyoshi; Uenaka, Junji; Kambayashi, Shaw; Higuchi, Kenji; Kume, Etsuo; Fujisaki, Masahide; Fujii, Minoru; Yokokawa, Mitsuo. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1989. 175p. (In Japanese). Order Number DE89906499/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

In 1987 Japan Atomic Energy Research Institute has started a ten-years program named HASP, i.e., Human Acts Simulation Program, for artificial intelligence and robotics research. In the HASP, a human-shaped robot reads and understands orders written in natural language, planning and producing a required sequence of actions, accesses to a device or an instrument recognizing its entity and dose the ordered work for plant maintenance. All of these processes including calculation of the radiation exposure of the robot are simulated by logical and numerical computations. The simulated actions of the robot in three-dimensional environments are displayed using a high speed computer for graphics. The aim of the HASP project is threefold, i.e., (1) to develop fundamental technologies for design of intelligent robots, (2) to develop technologies for automated and/or intelligent plants, (3) to provide researchers and engineers in nuclear field with basic and systematized artificial intelligence techniques. The research items are natural language understanding, goal planning by LISP calculus, pattern recognitions by neural network methods, plant modelling by solid modeller, biped robot simulations, graphic display of the robot motion, and a study of design concept of a Monte Carlo vector processor for high speed calculation of the radiation exposure. In this report research results attained in the second year of the HASP project are described. (author).

42910 (JAERI-M–89-031) **Summary of the CRAC experimental conditions and data.** Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1989. 93p. (In Japanese). Order Number DE89906501/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Experimental conditions and data of the CRAC for criticality accident simulation performed in France were rearranged. All the experiments which are reported in the experimental reports issued by French Commissariat a 1'Energie Atomique (CEA) are described in this report. Data of each experiment are on the summary table of specific experiment and easy to find the experimental conditions and data including the objectives and results. Relationship between the fundamental data is also briefly discussed. This report is a part of works in the TRACY Working Group in which the planning of the TRACY (Transient Experimental Critical Facility) experiments in the NUCEF (Nuclear Fuel Cycle Safety Engineering Research Facility) is being discussed. (author).

42911 (KFK–4476, pp. 297-308) **Investigation of pipeline connections on the JUTTA and PAULA test benches.** Boehme, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Ingenieurtechnik); Selig, M.; Ullrich, R. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1988. (In German). (CONF-8803228–: 7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.), 15-16 Mar 1988; PWA–44/88). In *Papers presented at the 7th status report of the Reprocessing and Waste Treatment Project.* Order Number DE89795557/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

In the framework of the final development and operational testing of FEMO pipeline flanges for the German reprocessing plant Wackersdorf, pipeline jumpers were tested in the assembly stand JUTTA for the observance of various specifications (impermeability, mechanical robustness, response to remote control, etc.) and in the test stand PAULA to check their impermeability in case of deformation. According to the present experiments still to be finished, these flange connections represent a reliable connection to the process modules of the reprocessing part. (RB).

42912 (NEI-NO–86 D5 23) **Refinements of TLP designs for ultra deep water applications.** Norsk Petroleumsforening, Oslo (Norway). 1988. (CONF-8808151–: Offshore northern seas conference and exhibition, Stavanger (Norway), 23-26 Aug 1988). In *Deepwater technology.* Order Number DE89776212/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Tension Leg Platform (TLP) technology is now the leading candidate for major deepwater developments. Success of the Hutton TLP spawned other developments such as the Jolliet, Heidrun and Snorre. These new fields are being developed using steel or concrete TLPs, and all three are located in water depths less than 2000 feet. However, the future of TLP design now points toward 4000 feet water dephts and beyond. In this paper, an attempt was made to identify some areas which could bring major cost reductions for the ultra deep water TLPs. These refinements must be examined carefully by the decisionmakers as well as the project managers for each application. A majority of the refinements proposed herein could be studied generalically but some will be site or project specific. Nevertheless, scientists and engineers will be challenged in the near future to quantify the merits of the above refinements. The rational decision making method, the Analytic Hierarchy Process (AHP) described in this paper, could become an integral part of TLP developments in ultra deep waters. 4 refs., 7 figs., 1 tab.

42913 (NRCC/IMR–26502) **Continuation of investigation of the effects of mechanical stress on the magnetic properties of**

pipeline steels for application in pipeline stress monitoring. Final report, July '84-July '86. Atherton, D.L.; Szpunar, J.A. National Research Council of Canada, Boucherville, PQ (Canada). Industrial Materials Research Inst. [1989]. 139p. (MICROLOG–87-04592). Available from National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, ON, CAN K1A 0R6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Magnetic inspection techniques are the principal methods used for in-service monitoring of pipelines. In order to exploit these techniques fully, a detailed understanding of the interrelationships between magnetic and mechanical effects is essential. Research is described in three basic areas: basic effects, stress due to gas line pressure on magnetic flux leakage signals, and design of a pipeline bending stress monitoring test rig using internal magnetometer surveys. A major achievement in the basic studies is the examination of the effect of stress on magnetostriction and magnetization for the same specimen. In order to analyze data, a method was introduced for separating reversible and irreversible processes. A method was also developed for analyzing irreversible processes using the Preisach diagram approach. The reversible component of magnetization is described by a Langevin function. In studies of magnetic flux leakage inspection and strain, it was shown that gas line pressure typically has a significant effect on the performance of magnetic leakage flux detectors used for in-service pipeline inspection. In general, increasing pressure and hence tensile stress in the wall tends initially to lower the amplitude of defect-induced signals. As the pressure is increased further, the effect is reduced and then reversed until, at high pressure, there is a substantial increase in signal amplitude. The effects are reversible with pressure and independent of defect penetration. The effects are considered to be due to overall stress-induced changes in permeability of the pipe wall steel in the general vicinity of the detector but not directly localized to the defect. 11 refs, 40 figs.

42914 (OH/RD–88-69-K) **Design of a multipurpose aerosol research facility.** Leung, H. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 41p. (MICROLOG–89-02550). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A multi-purpose aerosol research facility will be constructed in three stages to study ambient, high temperature and high humidity, and low temperature conditions, respectively. The facility will support fundamental aerosol research, high efficiency particulate aerosol (HEPA), and charcoal filter testing, insulator studies, and flow measurement calibration. This report describes a detailed design for the first-stage facility which will consist of two basic units, tunnel and drive system. The tunnel will be constructed in a modular fashion with the following fuctional units: bellmouth, aerosol injector, turbulence reducers, sampling section, and test section. The drive system will consist of a centrifugal fan with inlet vane and outlet damper control. System parameters such as humidity, temperature, velocity, flow rate, pressure drop, aerosol concentration, and size will be converted and stored in a PC/AT control/data-acquisition system. Cost estimates are provided. 7 refs., 10 figs., 12 tabs.

42915 (PB–89-861686/XAB) **Magnetic refrigeration: materials, design, and applications. January 1975-April 1989 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1975-April 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 66p. Available from NTISPC N01/MF N01.

This bibliography contains citations concerning cryogenics using magnetic refrigerants. Refrigerant properties, magnetic materials, and thermal characteristics are discussed. Magnetic refrigerators are used for helium liquefaction, cooling superconductors, and superfluid helium production. Carnot-cycle refrigerators, reciprocating refrigerators, parisitic refrigerators, Ericsson refrigerators, and Stirling-cycle refrigerators are among the types of magnetic refrigerators evaluated. (Contains 103 citations fully indexed and including a title list.)

42916 (PNL–6906-Vol.1) **Spent fuel assembly hardware: Characterization and 10 CFR 61 classification for waste disposal: Volume 1, Activation measurements and comparison with calculations for spent fuel assembly hardware.** Luksic, A. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 107p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC06-76RL01830. Order Number DE89015190/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Consolidation of spent fuel is under active consideration as the US Department of Energy plans to dispose of spent fuel. During consolidation, the fuel pins are removed from an intact fuel assembly and repackaged into a more compact configuration. After repackaging, approximately 30 kg of residual spent fuel assembly hardware per assembly remains that is also radioactive and requires disposal. Understanding the nature of this secondary waste stream is critical to designing a system that will properly handle, package, store, and dispose of the waste. This report presents a methodology for estimating the radionuclide inventory in irradiated spent fuel hardware. Ratios are developed that allow the use of ORIGEN2 computer code calculations to be applied to regions that are outside the fueled region. The ratios are based on the analysis of samples of irradiated hardware from spent fuel assemblies. The results of this research are presented in three volumes. In Volume 1, the development of scaling factors that can be used with ORIGEN2 calculations to estimate activation of spent fuel assembly hardware is documented. The results from laboratory analysis of irradiated spent-fuel hardware samples are also presented in Volume 1. In Volumes 2 and 3, the calculated flux profiles of spent nuclear fuel assemblies are presented for pressurized water reactors and boiling water reactors, respectively. The results presented in Volumes 2 and 3 were used to develop the scaling factors documented in Volume 1. 5 refs., 4 figs., 21 tabs.

42917 (SAND–88-3060C) **X-ray lithography studies of polysilane using a laser plasma x-ray source.** Kubiak, G.D.; Outka, D.A.; Zeigler, J.M. Sandia National Labs., Albuquerque, NM (USA). 1988. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-881155–75: Fall meeting of the Materials Research Society, Boston, MA (USA), 28 Nov - 3 dec 1988). Order Number DE89015390/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A laser-generated plasma source on monochromatized soft x-rays has been used to study the x-ray lithographic resist properties of poly(cyclohexylmethysilane-co-dimethysilane). X-ray absorption spectra near the Si $L_{2,3}$ edge of unexposed samples were measured to guide the choice of exposure photon energy. We find that poly(cyclohexyl-methylsilane-co-dimethylsilane) exhibits positive tone at x-ray energies near 105 eV (Si 2p resonance), a sensitivity of 1000 mJ/cm^2 and a contrast of 1.5. Sensitivity is found to increase markedly when exposed samples are held in air before development. Using simple wire mesh masks, estimates of the minimum achievable linewidth have been made. 17 refs., 4 figs.

42918 (SAND–89-0963C) **A proposal for an international brittle fracture acceptance criterion for nuclear material transport cask applications.** Sorenson, K.B.; Salzbrenner, R.J.; Nickell, R.E. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890631–61: International symposium on packaging and transporting of radioactive materials, Washington, DC (USA), 11-16 Jun 1989). Order Number DE89015408/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper presents a fundamental basis for a brittle fracture acceptance criterion, examine several existing criteria and propose examples for consideration as international brittle fracture acceptance criteria. The proposed criteria are intended to stimulate discussion in order to advance the development of a consensus approach. 8 refs., 1 fig., 1 tab.

42919 (UCRL–99648) **Overview of the DOE packaging review guide and the review process.** Fischer, L.E.; Chou, C.K. Lawrence Livermore National Lab., CA (USA). May 1989. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890631–60: International symposium on packaging and transporting of radioactive materials, Washington, DC (USA), 11-16 Jun 1989). Order Number DE89014046/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The principal purpose of the PRG (Packaging Review Guide) is to establish and maintain the quality and uniformity of reviews of

SARPs which are submitted to the DOE Certifying Official for approval. The PRG provides a well-defined base from which to evaluate proposed changes in the scope and requirements of SARP reviews. The PRG also provides information about the DOE certification policy and procedures to DOE field offices, DOE contractors, federal agencies, and interested members of the general public. The PRG is not a DOE order on packaging requirements but has been prepared for the guidance of the Packaging Certification Staff (PCS) in reviewing SARPs. An applicant submitting a SARP does not have to follow the guidelines in the PRG. 5 refs., 3 figs.

42920 (UCRL–100365) **Pulse and microwave characterization of a fiber-optic transmission link.** Sargis, P.D. Lawrence Livermore National Lab., CA (USA). 11 Jul 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890836–6: 33. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering, San Diego, CA (USA), 6-11 Aug 1989). Order Number DE89016638/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Experiments at the Nevada Test Site require high-bandwidth recording systems with wide dynamic range. A 1300-nm fiber-optic transmission link is being investigated for this application. This system performs with a bandwidth of 3 GHz and a dynamic range of 100. To gain a better understanding of the large-signal response of semiconductor laser diodes, an analysis of large-signal vs small-signal response has been conducted using pulse and microwave techniques. 1 ref., 6 figs.

42921 (Y–2412-8) **Y-12 Development Division technical progress report, period ending May 1, 1989: Part 8, Instrumentation and Evaluation Technology.** Johnson, D.H. (comp.). Oak Ridge Y-12 Plant, TN (USA). 8 Aug 1989. 20p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OS21400. Order Number DE89016455/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An optical alarm for large industrial vacuum systems has been developed to prevent overflow of vacuum filters and traps. The alarm prevents two problems: (1) nuclear reactions when the dirt contains both radioactive materials and water, and (2) overload of the vacuum system. The level of dirt in the trap is detected by the attenuation of light across the trap. Water in the trap is detected by light refraction at large angles of incidence to the water surface. To minimize sensitivity across the empty section of the trap and is used to normalize the first detector output. Logic circuits minimize sensitivity to large chunks of dirt moving in the trap. 4 refs., 11 figs.

42922 (Y/CM–0171) **The Computer-Integrated Enterprise (CIE) Program at the Oak Ridge Y-12 Plant: An executive overview.** Gingrich, T.U. (comp.). Oak Ridge Y-12 Plant, TN (USA). Jul 1989. 26p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OS21400. Order Number DE89015924/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The strategic and operational plans for the Computer-Integrated Enterprise (CIE) Program at the Oak Ridge Y-12 Plant are improving the plant's manufacturing performance and business functions by focusing on the automation and integration of plant operations made possible by the emerging computing and telecommunication technologies. By using CIE technologies, the plant is evolving from today's manufacturing environment to the more cost-effective, competitive, and flexible manufacturing environment of the 1990s. The program is committed to meeting the Computer-Integrated Manufacturing (CIM) directives established by the US Department of Energy (DOE) and providing the means by which operations can improve manufacturing performance of the Y-12 Plant. Projects that will support Y-12 Plant and Department of Energy objectives are being implemented through analysis of the manufacturing environment of today and that of the future. These projects will permit the plant to incrementally change the way it does business and systematically evolve toward the ideal manufacturing environment known as the factory of the future. This paper discusses the CIE program in more detail. 17 figs.

42923 (Y/DX–851) **Hydroforming tool-design advisor: (HTDA) programmatic goals, objectives, and status report.** Greer, J.T.; Dixon, J.H.; Davis, N.; Spann, M.A. Oak Ridge Y-12 Plant, TN (USA). 30 Jun 1989. 11p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OS21400. Order Number DE89015923/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The hydroforming process is important to the Y-12 mission because of its ability to produce precision, thin-wall part geometries that otherwise would be very difficult and expensive to manufacture using standard machining techniques. The hydroforming equipment was primarily obtained from commercial vendors; however, considerable expertise is required to utilize these machines with low-percentage part and/or tool-die rejection rate. Extensive engineering and operations "know-how" are necessary in order to maintain the current efficiencies, precision, and consistent quality. Key individuals who possess this knowledge are approaching retirement age and will be required to transfer their knowledge and expertise to other "less experienced" individuals. The primary focus of the HTDA effort is to capture the knowledge and hydroforming expertise of key experts who have established methods that are consistently accurate in determining compensations for the tool-die design, and to provide this information to the design engineer/draftsman.

42924 **Ultra-high-resolution photoelectron spectroscopy applied to superconductors.** Lynch, D.W. (Physics Dept. and Ames Lab.-US DOE, Iowa State Univ., Ames, Iowa (US) US). vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

Superconductors have gaps in the excitation spectra at the Fermi level. These gaps have been studied by far infrared absorption, microwave absorption, and tunneling studies. The gap widths are about 3.5 kT_c in the BCS model. Most simple Type I superconductors have values of T_c below 10 K, hence gaps smaller than 3 meV. Some type II superconductors have T_c up to about 25 K, hence gaps of up to 7 meV. Only half these gaps are below the Fermi level, so photoemission experiments detect gaps of 1.75 kT_c. These gaps have never been seen in photoemission measurements because adequate resolution is lacking. These gaps are known to be anisotropic, and angle-resolved photoemission is an ideal way to study the anisotropy, if adequate resolution can be achieved. The resolution of electron energy analyzers can be 5 meV or so, and sources with line widths less than this figure and adequate time averaged flux, offer hope that these gaps can be studied by photoelectron spectroscopy.

42925 **Flow of noncolloidal slurries in pipelines.** Hsu, F.L. (9517341); Turian, R.M.; Ma, T.W. *A.I.Ch.E. (American Institute of Chemical Engineers) Journal (New York) (USA),* 35(3): 429-442 (Mar 1989).

A multiphase model for the flow of dense, noncolloidal, settling slurries through horizontal pipelines, and an associated Galerkin-finite element numerical scheme to carry out computer simulations based on the model, were developed. The principal elements of the model are: equations for estimation of the velocity distributions for each component; and those for the concentration distributions. In the former, which are derived from the local volume-averaged, time-smoothed conservation of mass and momentum equations, the total stress is comprised of components to account of interparticle and particle-boundary as well as viscous and turbulent interacting. The governing equations for the concentration distributions are derived similarly from the convective diffusion equation, with the eddy diffusivity modified to account for the presence of the solid particles. Numerical simulations and detailed comparisons with experiment for the flow of gypsum, coal, crushed glass, sand and gravel, covering particle sizes from 38.3 μm to 13,000 μm, and pipe diameters from 4 cm to 49.5 cm, were carried. out. Agreement between model prediction and experiment is excellent.

42926 **Effect of geometry and interfacial resistance on current distribution at energy dissipation and metal/superconductor junctions.** Liu, M. (Department of Materials Science and Mineral Engineering, University of California, and Center for Advanced Materials, Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Berkeley, California 94720 (US)); De Jo *Journal of Materials Research (USA),* 4(3): 530-538 (May 1989). DOE Contract AC03-76SF00098.

Potential and current distributions and local energy dissipation due to Jouel heating in metal-superconductor junctions have been computed as a function of geometric parameters and interfacial resistance. The primary current distribution and power dissipation are highly nonuniform in the system. The secondary distribution and power dissipation, however, become more uniform as the interfacial resistance increases. Analysis indicates that zero contact resistance is not a stable situation since the primary distribution leads to local current densities exceeding the critical current density of the superconducting phase near the corner of the junction. Local contact failure might then initiate. A finite contact resistance is necessary for a practical application, and the minimum value of the contact resistance can be estimated from the operating current density (j_{avg}) of the device and the critical current density (j_{cri}) of the superconduting phase. To obtain an optimum value of the contact reistance, however, one further has to take into consideration the stability and reliability of the device performance, which is, in turn, directly related to the uniformity of the current distribution and power dissipation, to temperature fluctuation of the superconducting phases brought about by local power dissipation, and to the thermal management of the system. Furthermore, a nonuniform contact resistance layer of appropriate profile can redistribute the current more effiectively and more uniformly and hence reduce to the total power dissipation in the system for a given $j_{max}/_{avg}$ ratio obtained by a uniform resistance layer.

42927 Superconductor developments. Larbalestier, D. (University of Wisconsin-Madison (US)). *AIP (American Institute of Physics) Conference Proceedings (USA)*, 184(2): 1377-1392 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

I will cover the technology of the new oxide supeconductors and how they might relate to the existing superconductors. Fermilab and the high energy physics community in general have had much to do with the development of the "old" superconductors. Bednorz and Müller must be credited with the idea of setting out on the search for the new superconductors.

4203 Lasers

Refer also to citation(s) 42579, 42580, 42614, 43016, 43022, 43062, 43780, 43937, 43938, 44246

42928 (AD-A–205625/7/XAB) **Research studies on extreme-ultraviolet and soft-x-ray lasers. Final technical report, 23 November 1985-22 November 1988.** Harris, S.E.; Young, J.F. Stanford Univ., CA (USA). Edward L. Ginzton Lab. 24 Feb 1989. 10p. Available from NTIS, PC A02/MF A01.

This program consisted of experimental and theoretical studies of the physics, technology, and spectroscopy of extreme ultraviolet (XUV) and soft x ray lasers. It is a continuation of several predecessor programs. The overall objective of the work is to develop a class of lasers whose wavelengths span the 100- to 1000-A spectral region. Major accomplishment are summarized and resulting publication listed.

42929 (AD-A–205915/2/XAB) **Vibrational relaxation and collision-induced dissociation of xenon fluoride by neon.** Wilkins, R.L. Aerospace Corp., El Segundo, CA (USA). Aerophysics Lab. 1 Mar 1989. 35p. (TR–0088(3061)-1). Available from NTIS, PC A03/MF A01.

Rate coefficients were calculated for vibrational relaxation and collision induced dissociation of ground-state xenon fluoride in neon at temperatures between 300 and 1000 K for each of nine vibrational levels. These coefficients were calculated using a pairwise additive potential energy surface, which consists, of a Morse function for the XeF interaction and Lennard-Jones functions for the NeXe and NeF interactions. Rate coefficients are provided for temperature and v-dependences. The vibrational relaxation and dissociation processes occur by multiquanta transitions. Dissociation can take place from all v-levels, provided that the internal energy of the XeF molecule is close to the rotationless dissociation limit. The order of increase effectiveness of the various forms of energy in promoting dissociation in XeF was found to be translation-rotation-vibration. At room temperature, neon atoms were more efficient than helium atoms in the dissociation processes.

42930 (AD-A–206005/1/XAB) **Femtosecond pulse generation in a laser with nonlinear external resonator.** Mark, J.; Liu, L.Y.; Hall, K.L.; Haus, H.A.; Ippen, E.P. Massachusetts Inst. of Tech., Cambridge, MA (USA). 1989. 5p. (TR–426). Available from NTIS, PC A02/MF A01.

Pub. in Jnl. Optics Letters, Vol. 14, 48(1 Jan 1989).

A simple model is presented to describe mode locking in a laser coupled to a nonlinear resonator. It reveals a new mechanism for pulse shortening and shows that shortening does not rely on dispersion in the auxiliary cavity. Experimental results are given to support the basic predictions of the model.

42931 (AD-A–206368/3/XAB) **Cooperative phenomena for new coherent radiation sources. Final report, 14 May 1987-14 June 1988.** McFarlane, R.A. Hughes Research Labs., Malibu, CA (USA). Oct 1988. 48p. Available from NTIS, PC A03/MF A01.

The principal objective of this research is to investigate, both theoretically and experimentally, cooperative optical transitions in solids, with the goal of finding efficient systems for the generation of upconverted stimulated emission. Of interest also are new optical pair effects and studies of the resonance fluorescence and coherence on cooperative transitions. In the third year of the program, significant advances were made in the experimental aspects. Measurements of upconversion dynamics were made in erbium-doped crystals and in a fluorozirconate glass. Upconversion laser operation was observed at two visible wavelengths in $YLiF_4$:Er 5% and pumping pathways identified. Spectral and lifetime studies are reported for promising new laser host materials.

42932 (AD-A–206427/7/XAB) **Vertical-emitting, ring geometry, ultralow-threshold and ultra high-speed quantum-well lasers. Status report, July 1988-January 1989.** Bar-Chaim, N. Ortel Corp., Alhambra, CA (USA). 18 Feb 1989. 5p. Available from NTIS, PC A02/MF A01.

The main emphasis during this period was placed on the following efforts: (1) establishing a system and a method to fabricate gratings; (2) growing and qualifying quantum-well GaAs/GaAlAs material generated in the low-pressure MOCVD reactor; (3) fabrication of ultralow-threshold buried heterostructure lasers using liquid-phase-epitaxy regrowth; and (4) processing of standard double heterostructure ring lasers in order to determine the losses associated with curved structures. A system was designed and set up for fabrication of submicron gratings in order to be able to generate gratings required for vertically emitting lasers. The system consists of a He-Cd laser which emits light in the 325 nm UV line. The light is spatially filtered and expanded and then split into a couple of beams that create an interference pattern. Using this system, the authors exposed GaAs wafers that were coated with positive photoresist to create gratings with periods in the range of 0.2-1.0 micrometer. (A typical second order grating for GaAlAs laser is 0.24 micrometer).

42933 (AD-A–206620/7/XAB) **Effect of finite lower-level lifetime on q-switched laser.** Fan, T.Y. Massachusetts Inst. of Tech., Lexington, MA (USA). Lincoln Lab. Dec 1988. 7p. (JA–6149). Available from NTIS, PC A02/MF A01.

Pub. in IEEE Journal of Quantum Electronics, Vol. 24, No. 12, 2345-2349(Dec 1988).

Modeling of Q-switched laser operation for four-level lasers with finite lower-laser-level lifetime is presented. Extraction efficiency is reduced and pulse shape altered in comparison to the case of infinitely fast lower level relaxation. This reduction in efficiency is dependent on the ratio of the lower state lifetime to the cavity lifetime, the number of times above threshold, and occupancy factors of the upper and lower laser manifolds. The model is applied to the case of a Nd:YAG laser operating at 1.064 micrometers. At worst, the extraction efficiency is 68% of that expected for infinitely fast relaxation.

42934 (AD-A–206623/1/XAB) **Novel scalloped-mirror diffraction-coupled InGaAsP/InP buried-heterostructure laser arrays.** Yap, D.; Walpole, J.N.; Liau, Z.L. Massachusetts Inst. of

Tech., Lexington, MA (USA). Lincoln Lab. 20 Feb 1989. 4p. (JA–6180). Available from NTIS, PC A02/MF A01.

Pub. in Applied Physics Letters, Vol. 54, No. 8, 687-689(20 Feb 1989).

Diffraction-coupled arrays of InGaAs/InP buried-heterostructure lasers are reported. These arrays, fabricated by ion-beam-assisted etching and mass transport, have a novel scalloped mirror at the end of the coupling section that greatly increases the coupling between stripes and reduces the feedback into the same stripe. Far-field patterns show sharply defined lobes that are as narrow as 3. An output section with cylindrical mirrors was incorporated into the arrays to increase the power in the central far-field lobe. Threshold currents as low as 150 mA were obtained for eight-stripe arrays.

42935 (AD-A–206626/4/XAB) **Semiconductor surface-emitting laser diodes. Final draft report.** Wang, S.C.; Dziura, T.G. Lockheed Missiles and Space Co., Inc., Palo Alto, CA (USA). Research and Development Div. 30 Mar 1989. 128p. Available from NTIS, PC A07/MF A01.

The conventional edge-emitting laser diode uses either a single stripe or multiple structure consisting of an active layer in a plane parallel to the semiconductor surface; two cleaved facets, functioning as laser-cavity mirrors, are perpendicular to this active layer. It is relatively difficult to fabricate and diagnose in situ, and only one-dimensional laser arrays have been monolithically fabricated. The surface-emitting laser (SEL), on the other hand, utilizes both surfaces of the wafer as laser mirrors and the light output is perpendicular to the wafer plane. This makes planar fabrication and diagnosis easier, and more importantly, allows for two-dimensional (2-D) monolithic integration and array formation. This 2-D SEL array can be scale in number and size while maintaining a high filling factor. The SEL array diodes can also be individually addressed and controlled, and the output beam can also be easily accessed from both the front and back surfaces of the wafer. These features are very important and desirable when a large array of coherent-emission semiconductor lasers is needed.

42936 (AD-A–206713/0/XAB) **Investigation of plasma processes in electronic-transition lasers. Final report, 1 January 1985-31 December 1988.** Nighan, W.L. United Technologies Research Center, East Hartford, CT (USA). 28 Feb 1989. 97p. (UTRC/R–89-927162-1). Available from NTIS, PC A05/MF A01.

United Technologies Center has conducted an investigation of the fundamental processes affecting the operation, performance, and application of electrically excited lasers having potential utility in a variety of areas of importance to the Navy. Particular attention was focused on the broadband XeF(C to A) laser, which has the potential for efficient, tunable operation throughout the blue-green spectral region. The research at UTRC has been coordinated with a complementary ONR-supported experimental program conducted at Rice University. This Final Report summarizes the results of this investigation, and includes reprints of published papers in which specific results and conclusions of the research are described in detail.

42937 (AD-A–207052/2/XAB) **Compact, lightweight CO_2 lasers for SDIO applications. Final report, 30 September 1988-31 March 1989.** Jacob, J. Science Research Lab., Inc., Somerville, MA (USA). 11 Apr 1989. 108p. (SRL–07-F-1989). Available from NTIS, PC A06/MF A01.

During the past decade, substantial investments have been made in the development of gas-discharge-pumped CO_2 lasers for military and civilian applications. The DoD community and SDIO in particular is developing compact, lightweight CO_2 lasers for airborne and spaced-based radar applications directed toward target ranging, imaging, and discrimination. These CO_2 laser systems are being developed under the SDIO Lowkater Program, in the Airborne Laser Experiment (ALE) Program by the Army/SDC and in Lincoln Laboratory's space based CO_2 laser radar research and development program. The three major components of a CO_2 laser radar are the laser head and flow loop, the pulsed-power system and the optics and beam-control system. In this report, SRL presents a novel self-sustained discharge concept that should result in the stable and efficient extraction of large specific energies (50 J/liter atmosphere) for pulse lengths as long as 100 micro s.

42938 (AD-A–207114/0/XAB) **Alkali-rare gas and metal halide molecules as potential visible lasers. Final report, 1 October 1979-30 September 1980.** Eden, J.G. Illinois Univ., Urbana, IL (USA). Center for Supercomputing Research and Development. Oct 1980. 28p. Available from NTIS, PC A03/MF A01.

The major goal of this research effort is to identify those members of the alkali rare gas and metal halide molecular families which show promise as efficient, powerful and practical visible lasers. Laser photodissociation of polyatomic molecules and self-sustained discharge pumping are the primary tools being used to demonstrate lasing from these molecules.

42939 (AD-A–207134/8/XAB) **Quasi-aromatic heterocyclics as laser dyes. Interim technical report.** Pavlopoulos, T.G.; Boyer, J.H. Office of Naval Research, Arlington, VA (USA). 19 Apr 1989. 10p. (ONR-TR–12). Available from NTIS, PC A02/MF A01.

Superior laser dyes were recently discovered in the quasi-aromatic families of syn-dioxabimanes and pyrromethene-BF_2 complexes. The representative new dye mu-bis-(carboethoxy) methylene-syn-(methylene, methyl) bimane lased at 507 nm with 50% greater efficiency than was obtained with Coumarin 30. A similar determination showed 4, 4-difluoro-1,3,5,7,8-pentamethyl-4-bora-3a,4a-diaza-s-indacene to lase at 546 nm with about 300% greater efficiency than was obtained from Coumarin 545. These quasi-aromatic systems are readily available and offer desirable properties of stability (photo, thermal, and chemical), solubility, and diminished triplet-triplet absorption in the lasing spectral region. Selected spectroscopic and lasing properties of these new laser dyes are presented.

42940 (AD-A–207135/5/XAB) **Triplet extinction coefficients of some laser dyes. II. Interim technical report.** Pavlopoulos, T.G.; Golich, D.J. Office of Naval Research, Arlington, VA (USA). 19 Apr 1989. 21p. Available from NTIS, PC A03/MF A01.

The authors measured the triplet extinction coefficients T over the laser action spectral region of DODC, DMC, Sulforhodamine B, Rhodamine 575, Coumarin 523, Coumarine 521 Coumarin 504, Coumarin 498, Coumarin 490, LD466, bis-MSB, BBO, and OLIG0415. The different lines from an argon- and a krypton-ion cw laser were employed for excitation. McClure's method was again employed to measure the triplet extinction coefficients. The authors provide a simplified derivation of McClure's equation. The triplet extinction coefficient of Rhodamine 575 was also measured by using the depletion method and improving it by reconstructing for true triplet-triplet absorption. The value obtained is in good agreement with the one obtained by McClure's method.

42941 (AU/EE–U-79-11/80-14) **High power krypton fluoride laser development for fusion energy research. Final report.** Alberta Univ., Edmonton, AB (Canada). Dept. of Electrical Engineering. 1984. 46p. (CE–02685). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

A very complex KrF laser system has been built from the ground up and used for laser fusion research. The system's E-beam excited A-amplifier in a 3-beam, 3-pass multiplexed arrangement has been used routinely. Extensive operating experience has been gained with the full system. Extensive measurements of pulse compressing the output energy of the A-amplifier by stimulated Raman scattering have been made. A preliminary study has been undertaken of an alternative and as yet unreported approach using stimulated Brillouin scattering. This technique has the possibility of giving much shorter pulses at high efficiency and is therefore potentially very significant. Modifications have been implemented to improve performance of the laser system and, in particular, the E-beam pumped amplifier. Instrumentation has been implemented to monitor the spatial beam quality on each shot and in the equivalent focal plane of the final lens focusing the laser energy on target. Additional optical damage studies have been made of various dielectric coatings to evaluate their worthiness for high or low reflectance values on various mirrors, windows, etc. in the laser system. Finally, the pulse compressed laser beam has been focused on target and a variety of measurements begun. For these studies a new high vacuum target chamber has been fabricated and instrumented. A variety of diagnostics have been implemented to study target absorption, scattered

light, X-ray, and charged particle emission from the target. Additional modifications to the laser are being implemented that should increase the energy available, the efficiency of pulse compression, and the shortness of pulse achieved. 11 refs., 16 figs., 1 tab.

42942 (UCRL–99646) **Advanced phosphate glasses for high average power lasers.** Marion, J.E. Lawrence Livermore National Lab., CA (USA). Jul 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8904242–2: International congress on optical science and engineering, Paris (France), 24-28 Apr 1989). Order Number DE89016657/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Phosphate glass compositions with superior properties for operation as active elements in high average power lasers have been developed. Large, high optical quality castings of these new glasses that are free of metallic inclusions have been made by Schott Glass Technologies and by Hoya Optics. The laser requirements, glass development strategy, and the resultant laser and thermomechanical properties of the advanced phosphate glasses are analyzed. 14 refs., 1 fig., 1 tab.

42943 (UCRL–100420) **Flow, heat transfer, and wavefront distortion in a gas cooled disk amplifier.** Albrecht, G.F.; Sutton, S.B.; Robey, H.F.; Freitas, B.L. Lawrence Livermore National Lab., CA (USA). Jan 1989. 21p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890145–26: SPIE conference on optics, electro-optics and laser applications in science and engineering: OE/LASE '89, 15-20 Jan 1989). Order Number DE89015731/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The potential of the gas cooled disk architecture to operate at kilowatt to megawatt levels of average power is explored. The key issues investigated are flow and heat transfer in the cooling channel, the power required to perform the cooling and its implications for overall system efficiency, flow conditioning in the drift region, losses due to turbulent scattering, and beam quality due to optical distortions. In all cases an understanding of the issues leads to ways to mitigate or eliminate deleterious effects. Our conclusion is that the gas cooled disk geometry is an architecture which can lead to devices which are capable of average power levels reaching from a few kilowatts up to hundreds of kilowatts per beam line without stressing existing engineering or technology. 8 refs., 19 figs.

42944 **ASHURA.** Owadano, Y. (Electrotechnical Lab., Agency of Industrial Science and Technology, Tsukuba, Ibaraki 305 (JP)); Okuda, I.; Matsumoto, Y.; Tanimoto, M.; Koyama, K.; Yano, M. vp. of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA (USA), 25-29 Apr 1988).

Advanced system for high-power UV-radiation application (ASHURA) is a prototype KrF laser system which sets the guiding principles in the development of an efficient and compact fusion-driver. Key issues of the project are to increase the efficiency of amplifiers, evaluate pulse compression schemes, and investigate target interaction with a 2-20-ns UV laser pulse. ASHURA consists of a narrowband oscillator, three electron-beam-pumped amplifiers, and a pulse compression system. The whole system is expected to deliver 1-kJ optical energy in 100 ns and 600 J in 10 ns. The amplifiers are designed to be operated in a high-pumping-density (>1.0-MW/cm^3), high-laser-intensity (>10-MW/cm^2) region where high intrinsic efficiency (>10%) with a Kr-rich mixture is predicted. Damage thresholds of various coated optics have been the limiting factor in the design of the high-power UV laser system. As the result of a joint program of optics development, the full reflector damage threshold has exceeded 10 J/cm^2 for a 60-ns KrF laser pulse.

42945 **Stimulated-emission cross sections of the $^5F_1$–$^5I_5$ and $^5F_1$–$^5I_6$ transitions of Pm^{3+} in a phosphate glass.** Beach, R. (Lawrence Livermore National Laboratory, Livermore, California 94550 (US)); Weinzapfel, S.; Staver, R.; Solarz, R.; Shinn, M.; Krupke, W. *Optics Letters (USA),* 14(16): 856-858 (15 Aug 1989). DOE Contract W-7405-ENG-48.

We report a laser cavity measurement of stimulated-emission cross sections for both the $^5F_1$–$^5I_5$ (0.93-μm) and $^5F_1$–$^5I_6$ (1.1-μm) laser transitions of Pm^{3+} ions in a lead–indium–phosphate glass host. The measured cross sections for these two transitions are 1.8×10^{-20} (±11%) and 2.8×10^{-20} cm^2 (±22%), respectively. These values agree with previously reported values based on a Judd–Ofelt-type analysis of spectroscopic data.

42946 **Two-dimensional waveguide modeling of leaky-mode arrays.** Hadley, G. R. (Division 1124, Sandia National Laboratories, Albuquerque, New Mexico (US)). *Optics Letters (USA),* 14(16): 859-861 (15 Aug 1989). DOE Contract AC04-76DP00789.

We examine the structure and modal gains of the leaky modes of an infinite periodic index-guided array by direct solution of the two-dimensional Helmholtz equation. These findings serve to validate the physical insights suggested by our previous calculations based on the effective-index method and, in particular, confirm the concept of guide-width tailoring for affecting fundamental-mode operation of these devices at high-power levels. Our newer model also provides new insights into the mode-selection mechanism and demonstrates clearly the necessity of a full two-dimensional treatment if one is to describe the mode profiles or their relative gains accurately.

42947 **Fluorescence from RbF ionic excimers excited by laser-produced soft x rays.** Yang, T. T. (Rocketdyne Division, Rockwell International, 6633 Canoga Avenue, Canoga Park, California 91303 (US)); Gylys, V. T.; Harris, D. G. *Journal of the Optical Society of America B: Optical Physics (USA),* 6(8): 1536-1539 (Aug 1989).

In an inner-shell ionization of RbF generated in a heat pipe by laser-produced soft x rays, continua in the XUV have been observed at 130.4 and 155 nm. These continua show the same properties as the analogous transitions in the rare-gas fluoride molecules. The 130.4-nm fluorescence is attributed to the *B–X* transition, and a discussion of the origin of the 155-nm fluorescence is provided.

42948 **Resonant periodic gain surface-emitting semiconductor lasers.** Raja, M.Y.A. (4626000); Schaus, C.F.; McInerney, J.G.; Brennan, T.M.; Hammons, B.E. *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics (USA),* 25(6): 1500-1512 (Jun 1989).

A novel surface-emitting semiconductor laser structure with a vertical cavity, extremely short gain medium length, and enhanced gain at a specific design wavelength is described. The active region consists of a series of quantum wells spaced at one half the wavelength of a particular optical transition in the quantum wells. This spatial periodicity allows the antinodes of the standing wave optical field to coincide with the gain elements, enhancing the frequency selectivity, increasing the gain in the vertical direction by a factor of two compared to a uniform medium or a nonresonant multiple quantum well, and substantially reducing amplified spontaneous emission. Optically pumped lasing was achieved in a GaAs/AlGaAs structure grown by molecular beam epitaxy, with the shortest gain medium (310 nm) ever reported. Various other optoelectronic devices which depend on the interaction between an electromagnetic standing wave and a carrier population distribution can also benefit from this concept.

42949 **Free-electron lasers.** Brau, C. A. (Vanderbilt University, Nashville, TN 37235 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1615-1706 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

The lectures for a two-week intensive course on free-electron lasers given at Cornell University during the 1988 U.S. Particle Accelerator School (August 1–12, 1988) are presented. (AIP)

42950 **Free-electron lasers.** Pantell, R. H. (Electrical Engineering Department, Stanford University, Stanford, CA 94305 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1707-1728 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

An introduction to free-electron lasers is given. A short history of electron sources for and the operating characteristics of the free-electron laser are included in this short essay. (AIP)

42951 **Effect of the wavelength of the laser beam on the response of an evaporative light scattering detector.** Righezza, M. (9520226); Guiochon, G. *Journal of Liquid Chromatography (USA),* 11(13): 2709-2730 (1988).

The effects of the wavelength of the laser beam on the response of an evaporative light scattering detector (ELSD) are discussed. Data characterizing the response of the detector and its dependence on the sample size have been collected for six solutes, using a pulsed dye laser as light source. The experimental results suggest that there is little influence of the wavelength on the intensity of the scattered light. On the other hand, the noise decreases in proportion to the wavelength of the incident light beam. Thus, the detection limit (at constant value of the signal to noise ratio) decreases with decreasing wavelengths. The performance of the ELSD improves when a short wavelength is used.

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Refer also to citation(s) 41964, 41966, 41978, 42024, 42025, 42039, 42076, 42114, 42115, 42116, 42117, 42118, 42119, 42120, 42121, 42123, 42125, 42126, 42127, 42155, 42156, 42157, 42158, 42159, 42160, 42161, 42162, 42163, 42164, 42165, 42171, 42172, 42329

42952 (AD-A-206145/5/XAB) **Three-dimensional high-speed boundary-layer flows. Final report, September 1985-May 1988.** Inger, G.R. Iowa State Univ. of Science and Technology, Ames, IA (USA). Dept. of Aerospace Engineering. 28 Sep 1988. 61p. Available from NTIS, PC A04/MF A01.

This final report summarizes the research results obtained by a two-faceted basic theoretical investigation involving (1) fundamental analyses of three-dimensional viscous-inviscid interaction effects within high-speed turbulent boundary layers and (2) study of the influence of streamwise vortex arrays on the skin friction within attached or separated laminar layer flows.

42953 (AECL–9338) **Computations of flow and heat transfer in power plant condensers.** Carlucci, L.N. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Oct 1986. 10p. (CONF-860805–: International heat transfer conference, 17-22 Aug 1986). Order Number DE89635416/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

A computational procedure has been developed to model the two-dimensional flow and heat transfer in power plant condensers. This paper presents an outline of the procedure together with its application to model condensation in simple laboratory rigs and in a more complex power plant configuration.

42954 (CEA-CONF–9744) **Random excitation of heat exchanger tubes by cross-flows.** Axisa, F.; Antunes, J.; Villard, B.; Wullschleger, M. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques. 1988. 30p. (CONF-881119–: Symposium on flow induced vibration and noise, Chicago, IL (USA), 28 Nov - 2 dec 1988). Order Number DE89903183/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

For designing shell-and-tube heat exchangers against flow-induced vibration, a reasonable assessment of tube response to the random excitation by the crossflow is required. Resulting tube vibration amplitudes will not, usually, lead to failures on a short term basis. However, they can produce a progressive damage at the supports through fretting wear or fatigue. A considerable amount of experimental and theoretical work was already reported in the open literature, concerning flow-induced vibration in tube arrays. Nevertheless it is generally agreed that design oriented information on random excitation still remains insufficiently documented. This is largely because general interest was, at first, focused on fluidelastic instability and periodic wake shedding mechanisms, which can lead to catastrophic tube failures. This paper reviews information on this topics, gained at CEA Saclay during the past decade from several experimental programs. This includes tests performed in single phase flow (both air and water) and in two-phase flow (air-water and steam-water).

42955 (ENEA-RT-VEL–88-3) **Computation of pressure waves in shock tubes by a finite difference procedure.** Barbaro, M. Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Dipt. Reattori Veloci. Oct 1988. 21p. Order Number DE89761935/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A finite difference solution of one-dimensional unsteady isentropic compressible flow equations is presented. The computer program was tested by solving some cases of the Riemann shock tube problem. It was shown that a finite difference approach is capable of producing computational schemes of good overall accuracy. The deficiency of this method, like the other finite difference formulations, may be traced to the effect of the smearing of the pressure waves across the sharp discontinuities existing in the flow field. This is a consequence of the failure of the finite difference formulae to account for the discontinuities of derivatives of variables.

42956 (FEI–1956) **Semi-empirical theory of heat-transfer when boiling.** Sapankevich, A.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1988. 11p. (In Russian). Order Number DE89635418/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A semi-empirical model of heat-transfer when boiling based on simultaneous and indepenent (physically) existence of two mechanisms of heat transfer: convection and evaporation - during boiling is described. Intensity of convective heat exchange is characterized by the heat exchange coefficient and by temperature head "wall-liquid", and quantity of heat rate to evaporate is determined by mass flow of evaporated liquid, which depends on the value of mass transfer coefficient and liquid moving head. 10 refs.; 1 fig.

42957 (INIS-mf–11484) **Thermal non equilibrium in two phase flow.** ENEA, Rome (Italy). 1989. 553p. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

Twenty eight reports presented in the 7th Eurotherm seminar are contained in this publication. They cover the main aspects of the thermodynamics in relation to nuclear systems or having reference to them.

42958 (INIS-mf–11484, pp. 7-40) **Phenomenological modelling of non equilibrium flows with phase change.** Hewitt, G.F. (UKAEA Harwell Lab. (UK)); Govan, A.H. ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

Calculations are described in which new models for deposition and entrainment in annual flow are applied to a variety of conditions in annular and related flows. These include steady adiabatic flow, flow with evaporation, flow with dryout and post-dryout regions, flow with condensation and transient flows. The transient cases considered included both excursions with a flow decrease (transient dryout) and excursions with a flow increase (transient rewetting). Wherever possible, the predictions were compared with experimental data; this showed that the new models gave improved predictions in every case. Although it was not possible to make comparisons with experimental data in the case of flow transients leading to rewetting, several new aspects of this process emerged from the calculations. Specifically, it was found that the rewetting rate could be governed either by the progress of a front at which the film flowrate is zero (the reverse of a transient dryout situation) or by a front whose velocity is limited by the sputtering phenomenon. 29 refs.

42959 (INIS-mf–11484, pp. 41-53) **Applications of a simple analytical model to correlate steady state post DNB heat transfer data of water at medium pressure.** Johanses, K. (Technische Univ. Berlin (Germany, F.R.). Inst. fuer Kerntechnik); Mosaad, M. ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

A recently developed, simple two-fluid model was applied to correlate the steady-state heat transfer data for inverted annular flow film boiling of water in a vertically mounted circular tube at pressure from 0.1 to 2.0 MPa. Within the ranges of mass flux from 50 to 530 Kg/(m^2s), in let subcooling from 2 to 31 K, and Weber number of vapor less than 15, the average deviation of the predictions for the overall heat transfer coefficient, if compared to the 2829 available data points, was found to be 12.2%. As other applicable heat transfer correlations predict the same data base with three-fold larger

average deviations, the present analytical model may be considered quite effective despite of the obvious simplicity of constitutive relations assumed. For further improvement, extension of the empirical data base to higher inlet subcoolings and mass fluxes in the pressure range from about 0.2 to 1.8 MPa would be most welcome. 19 refs.

42960 (INIS-mf–11484, pp. 55-69) **Fluid dynamic characterization and flow reversal phenomena with reference to the reflux condensation.** Blengini, L. (Politecnico di Torino, Turin (Italy)); Del Tin, G.; Malandrone, M.; Panella, B.; Silvi, C. ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

In the present work an experimental study of flooding and flow reversal fluiddynamics has been performed, with particular reference to the air-water flow conditions. The test section is a 2200 mm long, 20 mm i.d. pyrex tube; water is injected from the top of the test section and air from the bottom end. The flooding and flow reversal occurrence conditions are investigated, as well as the downward water flow rate versus the air flow rate. Preliminary observations of the flow patterns for gas velocities ranging from flooding to flow-reversal conditions have been performed. Flooding data show a good agreement with the Wallis correlation at high liquid flow rate. The flow reversal tests confirm that flow reversal conditions depend only on the gas flow rate.

42961 (INIS-mf–11484, pp. 71-81) **Apparatus for gas temperature measurements in non equilibrium two-phase flow.** Pisani, C. (Genoa Univ. (Italy)); Tagliafico, L. ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

An attempt is presented to develop a device for testing new techniques for the measurement of gas temperature and flow in annular dispersed regimes. The reliability of the employed calorimetric technique is verified with experimental tests on the apparatus. Some problems are outlined about temperature and flow rates measurements for the liquid film and liquid droplets, characteristic of the flow regime analysed.

42962 (INIS-mf–11484, pp. 83-97) **Void fraction and pressure drop in subcooled forced convective boiling with refrigerant 12.** Staengl, G. (Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl A fuer Thermodynamik); Mayinger, F. ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

This paper presents investigations and results of void fraction and pressure drop of dichlordifluormethan (CCl_2F_2) in forced convective subcooled boiling. The data was taken at different heat fluxes in a 12 to 25 bar pressure range, the mass fluxes have been varied from 500 to 3000 kg/m^{2}s with an inlet subcooling in the range from 10 to 50 K. The experiments have been conducted in an annular test channel, with an 0.016 m inner diameter and 0.03 m outer diameter. The inner tube of the annulus was heated by direct current. The void fraction data was gaged with a γ-densitometer and a specially designed impedance void meter. The experimental results reveal that the void fraction is nearly constant from the onset of nucleation boiling to a subcooling of about Δ=10 K. The pressure drop shows a similar behaviour.

42963 (INIS-mf–11484, pp. 99-145) **CHF behaviour during pressure, power and/or flow rate simultaneous variations.** Celata, G.P. (ENEA, Casaccia (Italy). Centro Ricerche Energia); Cumo, M.; D'Annibale, F.; Farello, G.E.; Mariani, A. ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

The present paper deals with the results of an experimental investigation on critical heat flux in forced convective flow boiling during transients caused by simultaneous variations of pressure, flow rate and/or thermal power. The three parameters were varied according to an exponential law for the flow rate and the pressure decrease, and to a ramp and a step law for the input power increase. Experiments were carried out employing a tubolar test section which was electrically and uniformly heated. Test parameters included the flow rate half-flow decay time, several values of the initial power (before the transient) and the final power (at the end of the transient) in the case of step transients, and the slope of the ramp in the case of ramp transients, and the depressurization rate. An analysis of the experimental data was performed using the local conditions approach, and applying the quasi-steady-state method. The effect of the simultaneous variation of two or three main parameters on the time-to-crisis was also analysed for transients in which only one of the parameters was varied. 24 refs., 15 fig.

42964 (INIS-mf–11484, pp. 147-156) **Post dryout heat transfer and void fraction measurements relevant to a reactor reflooding.** Ralph, J.C. (UKAEA Harwell Lab. (UK)); Frankum, D.P.; Wade, C.D.; Black, P.S. ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

A programme of low flow post-dryout studies in a 9.8 mm bore tube has been carried out using the temperature controlled "hot-patch" technique to induce and stabilise the dryout zone. A lightweight traversing "one-shot" gamma densitometer was developed to obtain axial void fraction profiles downstream of dryout as a function of water flow and subcooling at 4 bar pressure. Flows in the range 25-150 kg m^{-2}s^{-1} and subcoolings of 5-50 grade centigrades in to the "hot-patch" resulted in dryout qualities of between 0 and 35% at entry to the directly heated flux controlled post dryout zone. It is shown that the mechanical bond between the copper hot-patch and the directly heated tube can significantly effect the dryout quality increasing the latter if bonding is poor. Tube axial temperature and void fraction profiles are presented together with heat transfer coefficients as a function of void fraction. The latter indicates that there appears to be a strong unifying correlation between the measured void fraction and the heat-transfer coefficient related to saturation temperature. Comparison of the experimental results with a current version of the TRAC LWR safety code indicates that some refinement is still required in the constitutional equations used to describe the post dryout situation relevant to reflood.

42965 (INIS-mf–11484, pp. 157-181) **Formation and heat transfer mechanism of vapor mass during nucleate boiling.** Chyu, M.C. (Texas Tech Univ., Lubbock, TX (USA)). ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

Formation mechanism of the vapor mushroom generated from a boiling wall with a high heating power is studied. Its heat transfer mechanism is also investigated by studying the evaporation of the liquid macrolayer between the vapor mass and the heating wall. It is demonstrated that heat conduction across the macrolayer and evaporation at the free surface is not a mode efficient enough to account for the major portion of heat transfer. Alternatively, it is proposed that macrolayer is primarily consumed through evaporation of much thinner microlayers at the bottoms of vapor stems penetrating the macrolayer. Analysis based upon the proposed mechanism shows the macrolayer does not totally dry out in a vapor-mass cycle before boiling crisis. Other mechanisms accountable for the consumption of macrolayer are also discussed.

42966 (INIS-mf–11484, pp. 183-209) **Turbulence structure and its effect on interfacial transport process in multiphase flow.** Bonerjee, S. (California Univ., Santa Barbara, CA (USA). Dept. of Chemical and Nuclear Engineering). ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non*

equilibrium in two phase flow. Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

New results on turbolence structure near fluid-fluid interfaces are presented. The experimental system is a liquid layer bounded on one side by a solid wall and on the other by a gas stream. The velocities and Froude numbers are such that interfacial waves are suppressed, so turbolence interactions with a plane interface can be studied. In the absence of shear (i.e. gas flow), the liquid flow is characterized by large rotational structures that arise from "bursts" generated at the wall that are ejected towards the interface. This intensely turbulent fluid arises from the lift off and chaotic breakdown of the low-speed streaks that characterize the wall layer. The ejections travel to the interface, reflect and flow back towards the wall giving the rotational motion. Interfacial transport processes are dominated by the periods when this "burst" fluid resides near the interface giving rise to a "patchy" turbulence structure. As the interfacial shear rate is increased by either cocurrent or countercurrent gas flow, high speed/low speed streaks are seen to form near the interface in a manner qualitatively similar to that at the wall. They also breakdown into "interfacial bursts" and it is this phenomenon that controls interfacial transport processes at high shear rates. Interfacial burst frequency a spacing scale with the local shear velocity (as do wall bursts). These observations indicate the funadamental structural importance of shear rate in turbulence and secondary role of boundary conditions. 22 refs.

42967 (INIS-mf–11484, pp. 223-234) **Description of mass, momentum and energy transfer in subcooled convective boiling using the non equilibrium.** Bartsch, G. (Technische Univ. Berlin (Germany, F.R.)); Wang, R.; Jansen, M. ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

The possibility of describing physical phenomena in the subcooled boiling region is of considerable importance to nuclear reactor technology and to the chemical process industry. In liquid cooled heat exchangers where high heat fluxes can be expected in a superheated boundary near the heated surface, bubbles beging to grow, although the mean enthalpy of the liquid has not reached the corresponding saturation temperature. They detach from the wall and move in to the liquid core, condense there in the surrounding subcooled water, contributing to the heating of the liquid. This process is characterized by a thermodynamic non-equilibrium.

42968 (INIS-mf–11484, pp. 235-252) **IVA2 application. Transient three dimensional non-equilibrium effects during APWR LOCA.** Kolev, N.I. (Bylgarska Akademiya na Naukite, Sofia (Bulgaria). Inst. za Yadrena Izsledvaniya i Yadrena Energetika). ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

Using the IVA2/005 computer code three dimensional effects during a LOCA for a homogeneous APWR are simulated. The formation and transport of void and droplets in a reactor vessel of the KWU-1300 type, responsible for the three-dimensional cooling of the core are shown as functions of time and space. The results prove that it is important to perform a three-dimensional analysis rather than a one-dimensional one in order to predict more realistic temperature distributions of the fuel rods, especially for the strong three-dimensional multi-velocity fields considered in this study.

42969 (INIS-mf–11484, pp. 253-261) **Application of the CATHARE advanced code to numerical benchmark exercises.** Ambrosini, W. (Pisa Univ. (Italy). Dipt. di Costruzioni Meccaniche e Nucleari); D'Auria, F.; De Pasquale, F.; Tempini, M.; Bestion, D.; Micaelli, J.C. ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

In this work the CATHARE V1.3 code was applied to two Numerical Benchmark Exercises proposed in the aim to test the behaviour of thermalhydraulic codes against some spurious numerical effects. In the analysis of the first exercise, which is related to a two-phase flow along a convergent-divergent nozzle, it was seen that the CATHARE code well predicts the expected physical trends in good agreement with the majority of other codes. The application of the code to the second exercise, concerning the water packing phenomenon, showed the presence of this numerical effect. From a sensitivity analysis on time step and mesh size, it was seen that the amplitude of the pressure spikes can be reduced increasing time step and decreasing the space increments.

42970 (INIS-mf–11484, pp. 263-286) **Correlating the experimental data in the rewetting of hot surface by a liquid falling film.** Castiglia, F. (Palermo Univ. (Italy). Dipt. di Ingegneria Nucleare); Olivieri, E.; Taebi, S.; Vella, G. ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

In the present work, after an overview of the main analytical results obtained by the authors on a two-region rewetting model a lot of experimental data relevant to the rewetting of metallic tubes by various coolant is considered in order to correlate theoretical and experimental results. 22 refs.

42971 (INIS-mf–11484, pp. 287-299) **Lumped parameter model for linear and non linear analysis of excursive and density wave instabilities in boiling channels.** Di Marco, P. (Pisa Univ. (Italy). Dipt. di Costruzioni Meccaniche e Nucleari); Clausse, A.; Lahey, R.T.; Drew, D.A. ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

A simple parameter model is presented which is suitable for both the linear and non-linear analysis of density-wave and excursive (Ledinegg) instabilities in a boiling channel subjected to a constant pressure drop (i.e. "parallel channel" boundary conditions); a lumped parameter heater dynamics model is also included. Both linear and non-linear stability analysis was performed; the marginal stability boundaries were calculated, and both subcritical Hopf bifurcations were detected. Finally, the limits of application of the quasi-linear Hopf bifurcation theory are discussed, particulary with respect to determining the range of potentially dangerous operating conditions of the system.

42972 (INIS-mf–11484, pp. 301-316) **Counter current flow modeling and Hydrogen generation influence on a PWR severe accident.** Buccafurni, A. (ENEA, Rome (Italy). Direzione Sicurezza e Protezione Sanitaria); Colagrossi, M.; Di Capua, G.P.C.; Naviglio, A. ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

This paper describes the main effects of the presence of noncondensable gases in the primary loop and the interface drag modeling in a counter-current flow during a severe accident in PWR reactor. The activities carried out by ENEA-DISP and University of Rome, in the framework of TMI-2 International Exercise organized by OECD/CSNI, stressed the importance, on the transient evolution, of noncondensable gases (mainly Hydrogen), and of the interface drag modeling in Counter-Current Flow Limiting (CCFL) conditions. The effects of the Hydrogen coming drag in the surge line are the likely causes of the anticipated pressurizer drainage at PORV closure timing. The pressurizer draining into the hot leg may be prevented by two mechanisms: the first is the counter-current limitation in the surge line; the second mechanism is the primary pressure increase due to reduction of primary natural circulation flow and steam generator heat transfer, caused by the presence of noncondensable gases in the primary loop. Calculation results show a partial pressurizer drainage after primary pumps trip and a faster drainage, after PORV closure with consequent core quenching. Such results differ from available experimental data on primary pressure and on pressurizer level. An underprediction of Hydrogen inventory and of interface drag in surge line flow condintions are likely to cause this mismatch.

42973 (INIS-mf–11484, pp. 317-335) **Mechanisms of nucleation in flashing flows.** Yan, F. (Louvain Univ. (Belgium)); Giot, M. ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

The mechanisms of nucleation have been analysed. Starting from the assumption that the activation of micro-cavities in the wall surfaces is the most probable nucleation mechanism in practical flashing system, the authors study in detail the nucleation in a micro-cavity. A three step nucleation criterion is proposed, namely: trapping cavity, activable cavity and active cavity. Then, a new nucleation model is presented. The output of the model is the prediction of the bubble departure frequency versus the thermodynamic state of the liquid and the geometry of the cavity. The model can also predict the nucleation site density if the nature of the wall and the surface roughness are know. The prediction have been successfully compared with some preliminary experimental results. By combining the present model with Jones'theory, the flashing inception is correctly predicted. The use of this nucleation model for the complete modelling of a flashing non-equilibrium flow is in progress. 30 refs.

42974 (INIS-mf–11484, pp. 337-345) **Non equilibrium choking effects in two phase mist expansion.** Konorski, A. (Polska Akademia Nauk, Gdansk (Poland). Inst. Maszyn Przepiywowych). ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

The occurrence of critical flow conditions, leading to flow choking effects, is one of the most significant phenomena in flow dynamics. In multiphase flows the mechanism of these effects and their relationship to sound wave propagation is essentially more complex than in simple gas dynamics. Interphase non-equilibrium, which is due to the retardation of transfer processes between the phases, affects substantially the course of two-phase processes. A high time-rate of the process at hand (e.g. rapid expansion) makes these effects particulary important. The aim of this paper is to analyze the choking conditions of non-equilibrium mist flows and to present calculation procedures for the determination of characteristic parameters of these processes.

42975 (INIS-mf–11484, pp. 347-362) **BLOWDOWN, a computer program for the calculation of LOCA.** Flinta, J. (INO Konsult, Nykoeping (Sweden)). ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

The main computation effort of blowdown in LWR LOCA analysis should be concetrated on the phenomenon in the ECCS evaluation codes. The cooling ability and the fuel peak clad temperature is not very sensitive to the accuracy of the break flow rate calculation. The choked flow calculation is just a tool in the calculation of the system pressure and water content history. The BLOWDOWN calculation program is written in Basic and calculates the transient course of the pressure, temperature and water content as a function of time in the pressurized system by means of the calculated choked water flow rate under LOCA conditions. The input data are the weight of the pressure vessel, the temperature distribution of the water in the pressure vessel and the tubing system, the pressure in the vessel, the amount of subcooled and hot water in the system and the flow restrictions down to the opening. The calculation model in the program is based on the concept that choked flow is controlled by the onset of the flow regime change from homogeneous bubble flow to dispersed droplet flow at the choking point. The choked flow correlation is that of the Bernoulli type and calculates the choked flow rate explicitly. This report presents the analysis of a number of the experimental test results obtained at 5 MPa at the Marviken Full Scale Critical Flow Test Facility. The agreement is very good and it verifies the applicability of the "change-of-flow-regime" model. It also supports the idea that BLOWDOWN might be used in LWR LOCA safety analysis as concers the ECCS evaluation.

42976 (INIS-mf–11484, pp. 363-372) **Heat transfer and evaporation analysis of multidroplets moving in another liquid.** Tadrist, L. (Centre National de la Recherche Scientifique, 13 - Marseille (France)); Sun, J.; Santini, R.; Pantaloni, J. ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

An experimental set-up has been conceived and realized to study the direct-contact evaporator of a dispersed liquid in another immiscible liquid. The study carried out on the freon (R113) - water and npentane -water allowed to determine the influence of different parameters on these systems. It has been shown that the volumetric heat exchange coefficient is little influenced by the continuous phase flow rate. However it increases with the augmentation of the dispersed phase flow rate. It is also observed that this coefficient is a decreasing function of the exchange length and the inlet temperature of the continuous phase. A one dimensional heat transfer model in the exchange column is established. With simplifying assumptions, the set of equations governing the heat transfer and two phase flow are proposed and solved numerically. In this system the vaporization process induces a volumetric expansion of the two-phase mixture. To match the experimental data, the coalescence effect is therefore taken into account in the model. The numerical results are discussed and compared with the experimental data.

42977 (INIS-mf–11484, pp. 373-388) **Theoretical investigation of the mechanical non equilibrium caused by the radial temperature distribution within two phase flows.** Bartsch, G. (Technische Univ. Berlin (Germany, F.R.). Inst. fuer Kerntechnik); Schroeder-Richter, D. ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

Mechanical non-equilibrium in the cross section of a two phase flow (boiling flow) has been suggested. This approach allows the explanation of the superheated thermodynamic state of the wall layer. The pressure difference can be simply calculated using the pressure of saturation corresponding to the know temperature of the heated surface. The authors gain valuable analytic equations for heat transfer DNB. It has been demostrated physically that DNB is caused by a sonic limit for the evaporation.

42978 (INIS-mf–11484, pp. 389-407) **Generalized solution for transient temperature distribution in an internally/externally insulated spherical shell.** Prasad, R. (Banaras Hindu Univ., Varanasi (India). Inst. of Tech.); Samria, N.K. ENEA, Rome (Italy). 1989. (CONF-8903110–: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

This paper presents the analytical solution for unsteady state temperature distribution in a spherical shell having thin layer of thermal insulation coating at the inner or outer surfaces. The formula has been derived assuming different initial temperatures of shell and insulation coating while the contact between them has also been assumed to be imperfect. The internal and external surface of the shell and coatings are exposed to the convective boundary conditions of the third kind. The generalized formula obtained has been used to obtain the warming-up period of the cylinder head of a diesel engine coated internally or externally by ceramic insulation material under starting conditions. A plot of temperature-time history and heat flow rates have been obtained. The problem considered has got its application in the transient thermal analysis of an adiabatic engine. Other similar problems in metallurgical, aeronautical, furnace design, nuclear reactor and boiler design applications may be solved by the formula obtained.

42979 (INIS-mf–11484, pp. 430-456) **DIPAC system. Application of the digital image processing technique to the dimensional and morphological characterization of particles**

bubbles and drops. Annunziato, M. (ENEA, Casaccia (Italy). Centro Ricerche Energia); Giammartini, S.; Pieroni, F. ENEA, Rome (Italy). 1989. (CONF-8903110--: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

In this report a system for dimensional and morphological characterization of particles, bubbles and drops is described. This system, named DIPAC (Digital Imaging for PArticles Characterization), is based on the application of digital image processing technique. Algorithms for the recognizing of objects respect to the background, the edge traking and the calculation of area, perimeter and others quantities are described, together with the main performances of the system. System finds applications in two-phase or two-component fluid-mechanics in fundamental or applied researches.

42980 (INIS-mf--11484, pp. 457-472) **Some notes on the two phase flow friction multiplier.** Lorenzini, E. (Bologna Univ. (Italy). Ist. di Fisica Tecnica); Spiga, M.; Tartarini, P. ENEA, Rome (Italy). 1989. (CONF-8903110--: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

In the present work the correlation proposed by Lorenzini for the calculation of the two-phase flow friction multiplier is analyzed and modified. In the first part of the paper the original formula has been rewritten in a new form, and some confrontations between experimental and numerical results are presented. In the second part, the correlation has been simplified with little approximations and then it has been empirically modified. The results obtained with the new formula are presented in conclusion of the work.

42981 (INIS-mf--11484, pp. 473-510) **One dimensional approach to the experimental investigation of steam generator performances.** Fabrizi, F. (ENEA, Casaccia (Italy). Centro Ricerche Energia); Rinaldi, L.; Urbani, G. ENEA, Rome (Italy). 1989. (CONF-8903110--: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

The present work reports some results of an experimental investigation about the performance of natural circulation U-tube Steam Generators. A one-dimensional approach has been adopted for developing the physical-mathematical model which the research is based on. The model has been applied to: (1) development and verification versus data of a computer code able to predict the SG performance; (2) modeling of an experimental mock-up based on suitable scaling laws that have assured similar behaviour of test section in comparison with SG prototype; (3) development of a semi-empirical model able to evaluate meaningful quantities not otherwise measurable in the SG, like quality and mass flowrate, aimed at a deep analysis of the SG performances. Experimental results have been compared with the various model applications. In particular steady-state data have been compared with semi-empiracal model predictions.

42982 (INIS-mf--11484, pp. 511-523) **Effect of surface roughness on boiling heat transfer.** Torikai, K. (Science Univ. of Tokyo (Japan)); Suzuki, K.; Mizuta, A. ENEA, Rome (Italy). 1989. (CONF-8903110--: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

In boiling heat transfer, many vapors are generated on the heating surface in high heat flux region. If many vapors are stayed on the heating surface, they are collaborated and developed to a vapor film. As the result, the heating surface is covered with the vapor film and the critical heat flux would be decreased. On the rough heating surface, boiling bubbles do not detach completely from the surface. In this case, the fluid state on the surface is considered as a kind of non-equilibrium two phase flow. Authors investigated experimentally the effect of surface roughness on the boiling heat transfer. The heating surfaces with lattice grooves which had different depth and width were employed as typical examples of surface roughness, and the grooving angle was approximately 60 degrees at the top. The authors obtained experimental results on water boiling for the rough heating surface that the critical heat flux decreased below a half value of the usual critical heat flux and the heat flux increased monotonously with the increasing of superheat of the heating surface under some condition of heating surface. The roughness of the heating surface in boiling heat transfer gives considerably an effect on the critical heat flux and the characteristics of heat transfer. The experimental results are different from the common knowledge about boiling heat transfer for the surface roughness. According to the present research, authors need some additional treatment to the surface of nuclear fuel elements and the design of electronic circuits etc.

42983 (INIS-mf--11484, pp. 525-535) **Modelling of hydraulics and heat transfer in falling film evaporators.** Patone, F. (Catania Univ. (Italy)); Palitto, M.; Patone, G.; Verdone, N. ENEA, Rome (Italy). 1989. (CONF-8903110--: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

Falling film evaporators are characterized by favorable working features in several industrial applications: (1) low mean liquid residence time in contact with heating surface; (2) liquid head free evaporation; (3) high vapor quality in once-through operation; (4) high heat flux vs reduced temperature difference. The used mathematical modelling is based on the Bergelin's correlation for shear stress at vapor-liquid interface; the film thickness and the liquid film side heat transfer coefficient are calculated by mean of the Dukler's theory, on the basis of the computed shear stress. The falling film evaporator behaviour is integrated with the evaluation of critical parameters related to the stability of the liquid film (minimum wetting rate, maximum vapor rate, maximum heat flux). The described model has been implemented in a computer code. An exemplifying output listing, concerning the vacuum evaporation of a tetraethyleneglycol-water system, is reported.

42984 (INIS-mf--11484, pp. 537-553) **Heat transfer in a rotating cryostat at high overloads.** Lutset, M.O. (AN SSSR, Novosibirsk (USSR). Inst. Teplofiziki); Zhukov, V.E. ENEA, Rome (Italy). 1989. (CONF-8903110--: 7. European seminar on thermal non-equilibrium in two-phase flow, Rome (Italy), 23-24 Mar 1989). In *Thermal non equilibrium in two phase flow.* Order Number DE89633367/JAW. Available from NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS.

The heat transfer to liquid nitrogen under conditions of large volume in a rotating cryostat has been experimentally investigated for overloads up to 5000. The map of heat transfer regimes has been constructed. The distribution of liquid temperature along the heater has been measured at a distance of 1 mm from it. The Coriolic force effect on the intensity of heat transfer and the temperature distribution of nitrogen near the heater has been discovered in the region of indeveloped boiling and convection. Two regions has been singled out in the developed boiling. The first one is characterized by the dependence of heat transfer intensity on no gravity force and the second one is characterized by its decrease with the overload increase according to Kutateladze-Malenkov formula.

42985 (INIS-mf--11503, pp. 72-75) **Two fluid model for critical two phase flow.** Dagan, R. (Technion-Israel Inst. of Tech., Haifa (Israel). Dept. of Nuclear Engineering); Elias, E.; Wacholder, E.; Olek, S. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152--: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

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42986 (PB--89-864458/XAB) **Heat pipes. January 1970-June 1989 (Citations from the US Patent data base). Report for January 1970-June 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 113p. Available from NTISPC N01/MF N01.

Supersedes PB--87-860433.

This bibliography contains citations of selected patents concerning the design, manufacture, and applications of heat pipes. The use of heat pipes in heat exchange systems for heat-storage, heat transfer, and heat utilization is discussed. Applications include semiconductor cooling, use in engine components, and building cooling and heating. (This updated bibliography contains 285 citations, 18 of which are new entries to the previous edition.)

42987 (UCRL–21165) **A computer code for calculating subcooled boiling pressure drop in forced convective tube flows.** Wong, Christopher F. California Univ., Davis, CA (USA). Dec 1988. 257p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89015709/JAW. Available from NTIS, PC A12/MF A01 - OSTI.

A calculation procedure, embodied in a computer code, was developed to calculate the convective subcooled boiling (SCB) pressure drop of water flowing in small diameter vertical or horizontal tubes under the condition of high heat fluxes. The present investigation is an extension of previous work performed by C.T. Kline in 1985. The computer code, presented then and now, numerically integrates the single-phase and separated-flow-model pressure drop equations from the inlet to the outlet of a heated tube. Efforts in this study were concentrated on identifying weaknesses in Kline's best code version and investigating his recommendations for future work. The calculation procedures for each flow regime in the tube were modified to give better overall results. New work focused primarily on the partially-developed boiling (PDB) and fully-developed boiling (FDB) regimes. The pressure drop predictions from each code version were compared to the experimental pressure drop results from the experimental investigations of Dormer/Bergles, Owens/Schrock, and Reynolds. 33 refs., 55 figs., 2 tabs.

42988 The flow of granular materials and aerated granular materials. Jackson, R. (Dept. of Chemical Engineering, Princeton Univ., Princeton, NJ (US)). vp. of Advances in multiphase flow and related problems. Papanicolaou, G. Society for Industrial and Applied Mathematics, Philadelphia, PA (1986). (CONF-8606245–: Society for Industrial and Applied Mathematics workshop on cross disciplinary research in multiphase flow, 2-4 Jun 1986).

Equations of motion for a non-cohesive granular material are presented, together with tentative constitutive relations for closure in the intermediate situation, where stress is generated by both frictional and collisional mechanisms. Corresponding boundary conditions are formulated, for both solid walls and free boundaries, and the influence of interstitial fluid is discussed briefly. Finally a solution of the complete equations is presented for the case of plane shear between horizontal plates.

42989 Interface instabilities and entrainment. Glimm, J. (Los Alamos National Lab., Los Alamos, NM (US)). vp. of Advances in multiphase flow and related problems. Papanicolaou, G. Society for Industrial and Applied Mathematics, Philadelphia, PA (1986). (CONF-8606245–: Society for Industrial and Applied Mathematics workshop on cross disciplinary research in multiphase flow, 2-4 Jun 1986).

Jets, fingers, droplets, bubbles and vortices are commonly observed modes of fluid interface instability in the large amplitude, highly nonlinear regime. Entrainment of these modes provides a mechanism for the mixing of two fluids separated by a contact discontinuity. In this report the authors study the highly nonlinear (late time) regime of bubble amalgamation for a Rayleigh-Taylor unstable interface. The latter instability is a gravity or acceleration driven instability of an interface between two fluids of different densities. The authors utilize the statistical model. In this model the dynamics is completely specified by the motion of a single bubble and the interaction (merger) of a pair of bubbles. The qualitative behavior of the model is discussed. Numerical solutions of the two fluid Euler equations for a gamma law gas are presented which show how to determine the parameters in the statistical model.

42990 Numerical solution of the three-dimensional Stokes' equations in the presence of suspended particles. Fogelson, A.L. (Courant Institute of Mathematical Sciences, and Dept. of Mathematics, Univ. of Utah, Salt Lake City, UT (US)); Poskin, C.S. vp. of Advances in multiphase flow and related problems. Papanicolaou, G. Society for Industrial and Applied Mathematics, Philadelphia, PA (1986). (CONF-8606245–: Society for Industrial and Applied Mathematics workshop on cross disciplinary research in multiphase flow, 2-4 Jun 1986).

A new fast numerical method for solving the three-dimensional Stokes' equations in the presence of discrete suspended particles is presented. The fluid dynamics equations are solved on a grid. The particles are represented by configurations of localized forces which are not constrained to move on the grid. These forces contribute to the force density term in the Stokes' equations. As a result, a single set of fluid dynamics equations holds at all points of the domain and there are no internal boundaries. Computational work increases only linearly with the number of particles, so large numbers (500-1000) of particles may be studied efficiently. Particle size, shape, and deformability may be prescribed. The method has been implemented to run on all CRAY computers: the implementation exploits the CRAY's vectorized arithmetic, and on machines with insufficient memory, it performs efficient disk I/O while storing most of the data on the disk. Applications of the method to sedimentation of one-, two-, and many-particle systems are described.

42991 Computational fluid dynamics for multiphase flow systems. Sha, W.T. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL (US)). vp. of Advances in multiphase flow and related problems. Papanicolaou, G. Society for Industrial and Applied Mathematics, Philadelphia, PA (1986). (CONF-8606245–: Society for Industrial and Applied Mathematics workshop on cross disciplinary research in multiphase flow, 2-4 Jun 1986).

Multiphase flow is receiving ever increasing attention, and has become one of the focal points in the engineering community. The driving force behind this trend is the fact that many industrial and commercial applications are multiphase flow systems. In addition, recent advances in computer technology, as well as numerical analysis, have allowed the use of computational fluid dynamics as an essential tool for analyzing and optimizing multiphase flow systems. In spite of both the attention and importance placed on multiphase flows, the current status of knowledge and understanding of multiphase flow systems in general, and computational fluid dynamics in particular, are far from satisfactory.

42992 Effective transport properties of multiphase media from the microstructure. Torquato, S. (Dept. of Mechanical and Aerospace Engineering and of Chemical Engineering, North Carolina State Univ., Raleigh, NC (US)). vp. of Advances in multiphase flow and related problems. Papanicolaou, G. Society for Industrial and Applied Mathematics, Philadelphia, PA (1986). (CONF-8606245–: Society for Industrial and Applied Mathematics workshop on cross disciplinary research in multiphase flow, 2-4 Jun 1986).

The authors derive a series representation of a general n-point distribution function H_n, that characterizes the microstructure of multiphase media, which enables them to systematically compute H_n for a certain class of models. It is shown that any of the statistical correlation functions which have arisen in expressions for the effective conductivity σ_e of composite media and the fluid permeability κ of porous media can be obtained from this single expression for H_n. Using the series representation of the H_n, the authors evaluate H_n for a system of randomly centered spheres, for any n. They also introduce and briefly describe a new set of statistical correlation functions which are expected to reflect information about percolating clusters in the system.

42993 A simple approach to highly sensitive tubular reactors. Hagan, P.S. (9506575); Herskowitz, M.; Pirkles, C. *SIAM Journal on Applied Mathematics (USA),* 48(5): 1083-1101 (Oct 1988).

The steady state operation of a long tubular fixed-bed reactor in which a single highly exothermic reaction is occurring is analyzed. To avoid temperature runaways, such reactors must be operated so that their temperature rises ΔT are small fractions of the adiabatic temperature rise ΔT_{ad}. So here asymptotic methods based on $\Delta T/\Delta T_{ad}L < 1$ are used to determine the radial temperature and concentration profiles. A simple one-dimensional (z only) reactor model is then derived by substituting these asymptotically correct radial profiles into the full two-dimensional reactor equations and then averaging in *r*. By comparing with numerical solutions of the two-dimensional reactor equations, it is found that the one-dimensional model accurately simulates the two-dimensional equations, even in

the highly sensitive runaway region. It is also shown that a runaway criterion derived from the model accurately predicts the runaway transition of the original two-dimensional reactor equations. Finally, multiple reactions are briefly considered, and it is found that the one-dimensional model does quite well, despite being derived only for the case of a single reaction. One difference to be noted between this one-dimensional model and previous ones is that the overall heat transfer coefficient U is not constant, but is a decreasing function of the temperature rise ΔT. This decrease occurs because the heat generation is increasingly concentrated near $r = 0$ as the reactor approaches runaway, and explains the disagreement between other one-dimensional models and the two-dimensional reactor equations near runaway.

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Refer also to citation(s) 41934, 41996, 42071, 42470, 42513, 42516, 42577, 42891

42994 (AECL–9090) **3-D fracture analysis using a partial-reduced integration scheme.** Leitch, B.W. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 28p. Order Number DE89635439/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This paper presents details of 3-D elastic-plastic analyses of axially orientated external surface flaw in an internally pressurized thin-walled cylinder and discusses the variation of the J-integral values around the crack tip. A partial-reduced-integration-penalty method is introduced to minimize this variation of the J-integral near the crack tip. Utilizing 3-D symmetry, an eighth segment of a tube containing an elliptically shaped external surface flaw is modelled using 20-noded isoparametric elements. The crack-tip elements are collapsed to form a 1/r stress singularity about the curved crack front. The finite element model is subjected to internal pressure and axial pressure-generated loads. The virtual crack extension method is used to determine linear elastic stress intensity factors from the J-integral results at various points around the crack front. Despite the different material constants and the thinner wall thickness in this analysis, the elastic results compare favourably with those obtained by other researchers. The nonlinear stress-strain behaviour of the tube material is modelled using an incremental theory of plasticity. Variations of the J-integral values around the curved crack front of the 3-D flaw were seen. These variations could not be resolved by neglecting the immediate crack-tip elements J-integral results in favour of the more remote contour paths or else smoothed out when all the path results are averaged. Numerical incompatabilities in the 20-noded 3-D finite elements used to model the surface flaw were found. A partial-reduced integration scheme, using a combination of full and reduced integration elements, is proposed to determine J-integral results for 3-D fracture analyses. This procedure is applied to the analysis of an external semicircular surface flaw projecting halfway into the tube wall thickness. (Abstract Truncated)

42995 (AECL–9186) **Computer assisted tomography for the non-destructive evaluation of hydrogen-induced cracking in steel.** Tapping, R.L.; Sawicka, B.D. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Jun 1986. 16p. Order Number DE89635440/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Computer assisted tomography (CAT) was used to assess hydrogen-induced cracking in steel exposed to an H_2S-saturated ('sour') environment. In this case the environment was the NACE TM-02-84 test for susceptibility to hydrogen-induced cracking. The feasibility of using CAT in this application was shown in a previous paper. This study extends the application of CAT to a quantitative assessment of the cracking. Optimal parameters for CAT imaging in such an application are determined and the advantages of using CAT in comparison to traditional inspection methods are discussed.

42996 (AECL–9258) **Application of acoustic emission to hydride cracking.** Sagat, S.; Ambler, J.F.R.; Coleman, C.E. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Jul 1986. 13p. Order Number DE89635441/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Acoustic emission has been used for over a decade to study delayed hydride cracking (DHC) in zirconium alloys. At first acoustic emission was used primarily to detect the onset of DHC. This was possible because DHC was accompanied by very little plastic deformation of the material and furthermore the amplitudes of the acoustic pulses produced during cracking of the brittle hydride phase were much larger than those from dislocation motion and twinning. Acoustic emission was also used for measuring crack growth when it was found that for a suitable amplitude threshold, the total number of acoustic emission counts was linearly related to the cracked area. Once the proportionality constant was established, the acoustic counts could be converted to the crack length. Now the proportionality between the count rate and the crack growth rate is used to provide feedback between the crack length and the applied load, using computer technology. In such a system, the stress at the crack tip can be maintained constant during the test by adjusting the applied load as the crack progresses, or it can be changed in a predetermined manner, for example, to measure the threshold stress for cracking.

42997 (INFO–0250-3) **Ultrasonic defect sizing using decibel drop methods. III. Fatigue cracks.** Mills, C.; Goszczynski, J.; Mitchell, A.B. Atomic Energy Control Board, Ottawa, ON (Canada). Mar 1988. 68p. Order Number DE89635442/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

An earlier study on the use of ultrasonic decibel drop sizing methods for determining the length and vertical extent nof flaws in welded steel sections was based on the scanning of machined flaws and fabrication fla(wa. The present study utilized the techniques developed to perform a similar study of the type of flaws expected to develop during service (e.g. fatigue cracks). The (ge.eral findings are that: a) the use of decibel drops of less than 14 dB generally undersize the length of fatigue cracks; and b) the use of decibel drop methods to determine vertical extent is questionable.

42998 (INFO–0254-1) **Crack propagation in tough ductile materials. Phase I.** Venter, R.D.; Sinclair, A.N.; McCammond, D. Atomic Energy Control Board, Ottawa, ON (Canada). Nov 1987. 79p. Order Number DE89635443/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The report describes and presents the J-resistance curves obtained as a function of crack extension for two representative tough ductile materials namely ASTM516 grade 70 plate steel and SA106 grade B pipe steel. The results were obtained using the ASTM standard method for determining J-R curves, E24.08, 12th Draft, 25th July, 1985. Both compact tension and three point bend tests were employed for the plate steel tests; only compact tension specimens were used to evaluate the pipe steel. All tests were carried out under load control conditions using specimens of different thickness and cut from known orientations within the parent material.

42999 (INIS-mf–11495, pp. 48-50) **Beam current monitoring in IBA.** Kenny, M.J. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Materials Science and Technology). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Integration of total charge in IBA is subject to error in situations where secondary electron losses occur or when insulating samples are used. This leads to errors in quantitative analysis. An alternate method based on scattering from a thin evaporated gold layer on a rotating vane has been developed. The vane uses an in vacuum stepper motor capable of operation in ultra high vacuum environments. The technique is quite satisfactory, but care must be taken in correcting for deadtime losses at high count rates.

43000 (INIS-mf–11503, pp. 87-91) **Reconstruction of CFP's image.** Ingman, D. (Technion-Israel Inst. of Tech., Haifa (Israel). Dept. of Nuclear Engineering); Merlis, Y. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

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In this paper we present the results of application of new adaptive image reconstruction algorithm to the degraded image of the CFP. The applied restoration procedure is a two-dimensional adaptive parabola fitting algorithm based on the diffusion model. The results show a significant improvement in contrast and noise level of the image. Moreover, the applied reconstruction operator is very sensitive and therefore the resulting image is much more convenient for feature extraction. The reconstructions, together with the considerations above, imply that the CFP is not a sufficient standard for high quality examination of radiographic techniques.

43001 (INIS-mf–11503, pp. 96-100) **Probability of detection in radiographic examination.** Bushlin, Y. (Technion-Israel Inst. of Tech., Haifa (Israel)); Notea, A. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

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A method is presented for evaluating the probability of detection (POD) of random oriented cracks in radiographic examination. The method is based on splitting the transfer operator describing the image generation process into a set of invertible suboperators. The crack was simulated by an equivalent slit of rectangular cross section. The inclination of the slit was expressed by suitable local dependent operator while the other blurring effects were expressed by a convolutable function. The influence of the slit parameters (width, height, orientation) and the measurement system parameters (noise, film type, blurring) were considered.

43002 (INIS-mf–11503, pp. 115) **Algorithm for reducing noise in radiographs.** Sonnenshaine, E. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering); Kushelevsky, A. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

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43003 (INIS-mf–11995) **Development of evaluation criteria for improving flaw description by manual ultrasonic testing.** Dortmund Univ. (Germany, F.R.). Fachgebiet Qualitaetskontrolle. 27 Aug 1986. 30p. (In German). Contract BMFT 03S370 6. Order Number DE89795694/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Theoretical considerations as well as measured data of defects in welds and cast iron pieces have shown that the multifrequency ultrasonic method allows to assign natural defects to a basic reflector type. Including known data of possible manufacturing - induced defects provides information on the type of defect. This leads to a more accurate flow size determination with the help of specific DGS diagrams set up for the various basic reflector types. Application of the multifrequency method largely rules out malinterpretations that may occur with the conventional DGS method. (orig./DG).

43004 (NIIAR–10(721)) **Assessment of the efficiency of nondestructive techniques in materials testing studies based on the information criterion.** Ivanov, V.B. Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR). 1988. 13p. (In Russian). Order Number DE89635444/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Problems of information theory application for assessment of the efficiency of using nondestructive methods of investigation are considered. Results of measuring empirical body of information, contained in experimental data files, can stand duty as additional criterion for choosing method, hardicare and software, providing for the method. 9 refs.; 4 figs.

43005 (NIIAR–20(731)) **Organization of data exchange between the BESM-6 and M-6000 computers for their processing in reactor materials testing automated scientific research system.** Marusev, V.I.; Ivanov, V.B.; Rusakov, V.L. and others. Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR). 1987. 12p. (In Russian). Order Number DE89633460/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Hardware and software for an interface between the M-6000 and BESM-6 computers, enabling to apply additional VT-340 videoterminal, are considered. The functional layout of the interface and block diagram of communication channel software are presented. Results of correlation analysis of the data of post irradiation fuel element tests, transmitted through the communication channel from M-6000 computer at the BESM-6 computer are described. 5 refs.; 3 figs.; 1 tab.

43006 (NIIAR–32(763)) **Investigation and construction of algorithms for leakage detection in steam generators of the BN-600 reactor.** Golushko, V.V.; Dunaev, V.S. Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR). 1988. 14p. (In Russian). Order Number DE89635445/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Applicabilities of optimal algorithms used when analyzing stationary random processes to detect leakes in BN-600 reactor steam generators are considered. Their application is shown to be impeded by nonstationary state of the process controlled. The method for "filtration" of non-stationary noises of durations at the input of an optimal detector permitting to decrease probabilities of false alarm and leakage signal is suggested. Problems on determination and justification of the parameter controlled to construct on its basis the heuristic noise-supressing detection algorithm are considered. The criterion permitting to determine the best parameter is suggested on the basis of the data obtained on the process controlled. 12 refs.; 1 fig.

43007 (PB–89-167357/XAB) **Tribology comes of age.** Hunt, M.S. Council for Scientific and Industrial Research, Pretoria (South Africa). 1987. 24p. (CSIR-ME–535). Available from NTIS, PC EE04/MF E04.

Portions of this document are not fully legible; North American Continent sales only.

This report discusses the progress of tribology in South Africa. An important milestone was reached when a Tribology Division was established in the National Mechanical Engineering Research Institute (NMERI) of the CSIR in August 1983. One of the motivations for creating this new division was the South African research program on alternative fuels, with particular emphasis on diesel engines. Initially, it was decided that the division would concentrate on the following subjects: (1) Condition monitoring by debris analysis; (2) Nondestructive condition monitoring of machinery; (3) Lubricity determination of alternative fuels; and (4) Tribological failure analysis.

43008 (PB–89-864649/XAB) **Nondestructive testing for microelectronics, semiconductors, and superconductors. January 1972-June 1989 (Citations from the International Aerospace Abstracts data base). Report for January 1972-June 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 89p. Available from NTISPC N01/MF N01.

Supersedes PB–87-861142; U.S. sales only.

This bibliography contains citations concerning the theory and various techniques for nondestructive testing or examination of microelectronic devices, semiconductor devices, and superconductors for the detection of flaws or defects which affect their properties and behavior. Some attention is also given to uniformity and quality control in integrated-circuit manufacturing. (This updated bibliography contains 188 citations, 37 of which are new entries to the previous edition.)

43009 (TS–8603) **Development of portable test equipment employing ultrasonic pulse-echo technique to determine flaws in concrete. Final report.** Macecek, M. Techno Scientific, Downeview, ON (Canada). 1986. 69p. (MICROLOG–87-04533). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

The overall objective of this work is the development of a state-of-the-art prototype of a portable ultrasonic concrete tester with pulse-echo capabilities. The report describes the first phase of the work, addressing general background research. The work was carried out in three main areas: development of an ultrasonic transducer with high penetrating power to serve as transmitter, and a

highly sensitive transducer as receiver; development of a hard pulser with 1000 V pulse; and measurements on concrete samples in laboratory structures as well as in the field to determine ultrasonic attenuation, velocities, damping, scattering and mode conversion in concrete. Of paramount importance was the study of pulse-echo or pitch and catch techniques with access from one side. This is the most important objective since the majority of engineering structures offer access from one side only. Existing commercial equipment is inadequate in large structures such as offshore drilling platforms, dams, and nuclear power installations. Both hard pulser and high sensitivity transducers have been successfully developed which, when combined with the narrow band filtered amplifier, gave penetrating capabilities of about 40 ft from side. The modules were tested in the field and evidence is presented to support the above claim. 62 refs., 27 figs., 6 tabs.

43010 (UCRL–52000-88-10, pp. 9-22) **Computed tomography for nondestructive evaluation.** Azevedo, S.G.; Martz, H.E.; Brase, J.M. Lawrence Livermore National Lab., CA (USA). Oct 1988. In *Energy and technology review.* Order Number DE89005308/JAW. Available from NTIS, PC A03/MF A01.

The status of current and planned CT technologies for industrial inspections at LLNL are described. Research is being continued to develop new techniques to advance the state of the art while supplying Laboratory scientists with production facilities to gather the most-complete information about their materials and assemblies. Research efforts are concentrated in the areas of scanner development and characterization, image-reconstruction algorithm development, parallel implementation of algorithms on new, fast, computer architectures, and novel data-analysis and image-display techniques. Computed tomography has become a very valuable nondestructive evaluation technique for both industry and medicine, and the utility of CT and the detail of CT imaging will continue to improve. 14 references, 9 figures, 3 tables.

43011 (WIC–RC203186) **The design, construction and commissioning of a wide plate test facility. Final report.** Glover, A.G.; Pick, R.J. Welding Inst. of Canada, Oakville, ON (Canada). 1986. 41p. (MICROLOG–87-02207). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

The need to assess the risk of fracture at low temperatures is essential in view of forthcoming requirements for Canadian frontier oil and gas developments. As part of the overall Canadian effort to study these requirements, a wide plate test facility was constructed to study the fracture characteristics of welded components. The facility is now fully operational. The test rig is a rigid machine intended for studying crack initiation, and short crack propagation and arrest. The rig can test plates up to 1220 mm in width with a maximum load capability of 4000 tons. The test plates can be locally cooled and the facility is fully instrumented. A commissioning fracture test has been successfully completed. 17 refs., 11 figs.

43012 (ZJE–280) **Measuring the thickness of austenitic weld deposits on carbon steel walls using a magnetic method.** Wagner, K. Skoda, Plzen (Czechoslovakia). 1988. 17p. Order Number DE89635446/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The theoretical background is described of a magnetic method characterized by a marked compensation of the undesirable effect of δ-ferrite content in the deposit, on the accuracy of measuring deposit thickness. A description is also given of the basic types of sensors and the results are summarized of comparing measurements performed on weld deposits of WWER-type reactor pressure vessels. (author). 7 figs., 5 refs.

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Refer also to citation(s) 41777, 41858, 42615, 42740

43013 (AD-A–206105/9/XAB) **Effects of High-Altitude Electromagnetic Pulse (HEMP) on the Northern Telecom Inc. DMS-100 (trademark) switch. Volume 1. Executive summary. Final report.** Booz, Allen and Hamilton, Inc., Bethesda, MD (USA). Sep 1988. 17p. Available from NTIS, PC A03/MF A01.

See also Volume 2, AD-A206 106.

This report is part of a three volume set that presents the results of simulated High Altitude Electromagnetic Pulse (HEMP) testing of a DMS-100 switching system. This volume presents a brief discussion of the test events and the test results, and summarizes the conclusions and recommendations of the test program. Volume II is a detailed description of the test procedures, the test results, and the mitigation alternatives evaluated. Volume II also presents a discussion of the conclusions and recommendations of the program. Volume III describes the post-test analysis of the measured electromagnetic fields and induced transients. Volume III also includes a comparison of the characteristic attributes of the various simulator environments.

43014 (AD-A–206106/7/XAB) **Effects of High-Altitude Electromagnetic Pulse (HEMP) on the Northern Telecom Inc. DMS-100 (trademark) switch. Volume 2. Test program. Final report.** Booz, Allen and Hamilton, Inc., Bethesda, MD (USA). Sep 1988. 90p. Available from NTIS, PC A05/MF A01.

See also Volume 3, AD-A206 107.

This report is part of a three volume set that presents the results of simulated High-Altitude Electromagnetic Pulse (HEMP) testing of a DMS-100 Switching System. This volume is a detailed description of the test procedures, test results, and the mitigation alternatives evaluated. This volume also presents a discussion of the conclusion and recommendations of the program.

43015 (AD-A–206107/5/XAB) **Effects of High-Altitude Electromagnetic Pulse (HEMP) on the Northern Telecom Inc. DMS-100 (trademark) switch. Volume 3. Data analysis. Final report.** Booz, Allen and Hamilton, Inc., Bethesda, MD (USA). Sep 1988. 91p. Available from NTIS, PC A05/MF A01.

See also Volume 1, AD-A206 105.

This report is part of a three volume set that presents the results of simulated High-Altitude Electromagnetic Pulse (HEMP) testing of a DMS-100 Switching System. This volume describes the post test analysis of the measured electromagnetic fields and induced transients. This volume also includes a comparison of the characteristic attributes of the various simulator environments.

43016 (AD-A–206270/1/XAB) **Development of high-power CARM (cyclotron auto-resonance maser) oscillators. Memorandum report, October 1987-October 1988.** Fliflet, A.W.; McCowan, R.B.; Sullivan, C.A.; Kirkpatrick, D.A.; Gold, S.H. Naval Research Lab., Washington, DC (USA). 14 Mar 1989. 27p. (NRL-MR–6388). Available from NTIS, PC A03/MF A01.

The Cyclotron Auto-Resonance Maser (CARM) is under investigation at the U.S. Naval Research Laboratory as an efficient source of high-power millimeter-wave and submillimeter-wave radiation for applications such as plasma heating, advanced rf accelerators, and space-based radars. A short-pulse 100 GHz CARM oscillator experiment based on a 600-kV, 200-Amp, 50-nsec electron beam is under way. The mode-selective, high-Q waveguide cavity with rippled-wall Bragg reflectors is designed to operate in the TE61 mode. A novel code cathode diode is used to produce a high quality annular beam with a momentum pitch ratio of 0.6. The cathode features nonemitting focusing electrodes and an annular velvet emitter. The main objective of the experiment is to demonstrate high efficiency approx. 20% at a power of approximately 20 MW. In addition, a long pulse 250 GHz CARM oscillator experiment based on a 500-kV, 100-Amp, 1-microsec MIG-type thermionic cathode electron gun is planned. The design of these experiments and the optimization of CARM oscillator efficiency are discussed.

43017 (AD-A–206624/9/XAB) **Defect-related dielectric breakdown, charge trapping, and interface-state generation of gate oxides grown on zone-melting-recrystallized silicon-on-insulator films.** Lee, C.T.; Chen, C.K. Massachusetts Inst. of Tech., Lexington, MA (USA). Lincoln Lab. 15 Jan 1989. 6p. (JA–6183). Available from NTIS, PC A02/MF A01.

Pub. in Jnl. of Applied Physics, Vol. 65, No. 2, 646-659(15 Jan 1989).

Dielectric breakdown was investigated for gate oxides grown on 0.3- and 1-micrometer-thick zone-melting-recrystallized (ZMR) silicon-on-insulator films, and also for oxides on 0.65- and 0.84-micrometer-thick films thinned from 1-micron-thick films by thermal

oxidation. In addition, charge trapping and interface-state generation have been studied for 1-micrometer-thick ZMR films. The gate oxide grown on a 1-micrometer-thick ZMR film is significantly better than that grown on a 0.3-micrometer-thick ZMR film. The weak spots for the breakdown of gate oxides are identified and correlated with defects in the ZMR films by optical Nomarski interference contrast microscopy and scanning electron microscopy. In comparison to its counterpart on bulk Si, the gate oxide grown on a 1-micrometer-thick ZMR film is characterized by a slightly lower breakdown field, larger positive charge generation, higher electron trapping, and larger interface-state generation.

43018 (CONF-890665–41) **Measurement and mechanisms of photoenhanced electron attachment: Implications for an optically-controlled diffuse discharge opening switch.** Pinnaduwage, L.A.; Christophorou, L.G.; Hunter, S.R. Oak Ridge National Lab., TN (USA). 1989. 4p. Sponsored by DOE/ER;OGA. DOE Contract AC05-84OR21400. CHE-8813466. From 7. Institute of Electrical and Electronics Engineers pulsed power conference; Monterey, CA (USA); 12-14 Jun 1989. Order Number DE89015859/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Capacitive energy storage has commonly been used in technically-established pulsed power generators. However, the increasing demand for high power pulsed equipment and the fact that inductive energy storage has larger energy storage density, triggered investigations of the possibility of using inductive energy storage in pulsed power applications. The critical component in an inductive energy storage system is a fast, repetitive opening switch for which an optically-controlled diffuse discharge opening switch appears to be promising possibility. Optically-enhanced electron attachment via mechanisms (i) has been observed in several gases and successful operation of diffuse discharge switches using mixtures of these gases with buffer gases has been carried out recently. We have observed enhanced electron attachment to several molecules (mixed with nitrogen) when irradiated by excimer laser radiation. 10 refs., 5 figs.

43019 (PB–89-189344/XAB) **Narrow-angle laser-scanning microscope system for linewidth measurement on wafers.** Nyyssonen, D. CD Metrology, Inc., Germantown, MD (USA). Apr 1989. 111p. (NISTIR–88/3808). Available from NTIS, PC A06/MF A01.

The integrated-circuit industry in its push to finer and finer line geometries approaching submicrometer dimensions has created a need for ever-more accurate and precise feature-size measurements to establish tighter control of fabrication processes. In conjunction with the NBS Semiconductor Linewidth Metrology Program, a unique narrow-angle laser measurement system was developed. The report describes the theory, optical design, and operation of the system and includes computer software useful for characterizing the pertinent optical parameters and images for patterned thin layers. For thick layers, the physics is more complex and only elements of the theory are included. For more detail the reader is referred to several related reports listed in the references.

43020 (PB–89-864193/XAB) **Computer-aided design and manufacturing: optical equipment. January 1970-June 1989 (Citations from the NTIS data base). Report for January 1970-June 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 66p. Available from NTISPC N01/MF N01.

Supersedes PB–86-872637.

This bibliography contains citations concerning the applications of computer aided design and manufacturing to optical lenses, lasers, and holography. Some citations refer to optical ray tracing as a part of the design process, and to the design of tools to grind lenses. Excluded from this bibliography are citations pertaining to electron beam optics. (This updated bibliography contains 104 citations, 10 of which are new entries to the previous edition.)

43021 (SAND–88-3403C) **Application of image analysis for infrared microspectroscopic detection of contaminants on microelectronic devices.** Ward, K.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 11p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890674–4: 7. international conference on Fourier transform spectroscopy, Fairfax, VA (USA), 19-23 Jun 1989). Order Number DE89015393/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The use of infrared microscopy imaging for the location and indentification of contaminants on microelectronic devices is discussed. Several methods are compared for the reconstruction of images from the infrared spectrum acquired at each pixel. Peak-height or peak-integration methods require prior information about the contaminant to narrow the spectral region of interest. These methods were found to be superior to full spectrum methods. When full-spectrum methods must be used, Gram-Schmidt reconstruction was found to perform slightly better than the integration method. 2 refs., 4 figs.

43022 Electro-optic sampling of high-speed, InP-based integrated circuits. Wiesenfeld, J.M. (9500343); Tucker, R.S.; Burrus, C.A.; Antreasyan, A.; Taylor, A.J. vp. of Proceeding of a topical meeting on picosecond electronics and optoelectronics (technical digest). Optical Society of America, Washington, DC (1987). (CONF-870114–: 2. IEEE/OSA topical meeting on picosecond electronics and optoelectronics, 14-16 Jan 1987).

Multigigahertz waveforms in an InGaAs/InP MISFET inverter circuit have been sampled noninvasively using pulses from a gain-switched InGaAsP laser. Propagation delays of 21 ps per MISFET stage have been measured.

43023 Silicon pulse sharpening diodes - Switching kilovolts in 10's of picoseconds. Pocha, M.D. (9513035); Wiedwald, J.D.; Dease, C.G.; Contreras, M.M. vp. of Proceeding of a topical meeting on picosecond electronics and optoelectronics (technical digest). Optical Society of America, Washington, DC (1987). (CONF-870114–: 2. IEEE/OSA topical meeting on picosecond electronics and optoelectronics, 14-16 Jan 1987).

Silicon diodes, operating in avalanche second breakdown, are used to generate electrically triggered, 2-3-kV pulses with rise times approaching 60 ps. This paper describes the process.

4209 Waste Processing Plants and Equipment

Refer also to citation(s) 42389

43024 (WCWS–8309) **Proceedings of the [35th annual] western Canada water and sewage conference.** Western Canada Water and Sewage, Calgary, AB (Canada). 1983. 222p. (CONF-8309416–: Western Canada water and sewage conference, 21-23 Sep 1983; CE–02682). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

Major topics covered by this conference include water treatment processes, equipment and facilities; sewage and sludge treatment and the production of fuels from waste materials. Separate abstracts have been prepared for two papers.

43025 (WCWS–8309, pp. 29-33) **Operation and control of anaerobic digesters.** Alkema, T. (Gore & Storrie, Ltd., Edmonton, AB, Canada). Western Canada Water and Sewage, Calgary, AB (Canada). 1983. (CONF-8309347–: 28. annual conference of the Spectroscopy Society of Canada, Ottawa, Ontario (Canada), 1 Sep 1983; CE–02682). In *Proceedings of the [35th annual] western Canada water and sewage conference.* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

The anaerobic digestion process is one of the most widely used methods of processing sewage sludge. The production of digester gas during this process makes it a net energy producer. This paper provides a brief description of the anerobic digestion process. It also provides a discussion of operating papameters which the process operator can monitor and control to optimize the process.

43026 (WCWS–8309, pp. 195-202) **Fuel production from sewage sludge.** Bridle, T.R. (Environment Canada); Campbell, H.W. Western Canada Water and Sewage, Calgary, AB (Canada). 1983. (CONF-8309347–: 28. annual conference of the Spectroscopy Society of Canada, Ottawa, Ontario (Canada), 1 Sep 1983; CE–02682). In *Proceedings of the [35th annual] western Canada water and sewage conference.* Available from CANMET/TID, Energy,

Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

The high cost of sewage sludge disposal, difficulties in licencing disposal sites, and the potential for legal restrictions on its disposal, all indicate the need for alternative resource recovery solutions for sludge disposal. This paper describes the application, to Canadian sludges, of the Tubingen process for the conversion of sludge into oil and char. Experiments conducted at the Environmental Protection Service Waste Technology Centre, using a batch reactor system, have confirmed that Canadian sludges are amenable to conversion to liquid and solid fuels. Raw sludges containing a mixture of primary and waste activated sludge from sewage treatment plants in Toronto, Hamilton, and Burlington, Ontario were evaluated. Oil yields of up to 25% appear to be readily achievable and thermal efficiencies of greater than 90% can be realized. The production of straight chain hydrocarbons appears to be unique to this process. Data generated to date indicates that net energies of 10-15 MG/kg of dry sludge should be achievable for the thermal conversion process, provided mechanical dewatering of the sludge is practiced. 13 refs., 1 fig., 4 tabs.

43027 (WCWS–8409) **Proceedings of the [36th annual] western Canada water and sewage conference.** Munsie, D. (ed.). Western Canada Water and Sewage, Calgary, AB (Canada). 1984. 284p. (CONF-8409417–: Western Canada water and sewage conference, Calgary (Canada), 19-21 Sep 1984; CE–02683). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

Major topics covered by this conference include water treatment processes, computer applications, materials, equipment, and facilities. Sewage and sludge treatment are also treated as well as non-conventional utilization of waste materials. Separate abstracts have been prepared for two papers.

4210 Combustion Systems

Refer also to citation(s) 41587, 42352, 42897, 43303

43028 (AD-A–206949/0/XAB) **Survey of microcleaning methods for application to Army coal-fired plants. Final report.** Northrup, J.; Jongkind, C.; Schanche, G. Army Construction Engineering Research Lab., Champaign, IL (USA). Feb 1989. 37p. (CERL-E–89/05). Available from NTIS, PC A03/MF A01.

Many Army installations use coal-fired boilers in their physical plants. These facilities are now facing more rigorous enforcement of regulations governing air-pollutant emissions, largely due to the increased concern over acid rain. Of particular significance to these plants is that new standards have lowered the acceptable level of sulfur oxides (SOx) in the exhaust. Compliance with these regulations will have major economic impact on the plants' operating costs. The U.S. Army Construction Engineering Research Laboratory (USACERL) is investigating emission control technologies to find the most cost-effective way of meeting the new standards for SOx. Several options are available, including flue-gas desulfurization, fluidized-bed combustors, and precombustion cleaning. This report focuses on microcleaning - one form of precombustion treatment to remove SOx and other particulates before the coal is burned, eliminating these byproducts from the emission. Three types of microcleaning were evaluated: chemical, biological, and physical. Many of the chemical and biological processes are still in the early stages of development and have not been commercialized. In addition, all of the processes were found to be more expensive than flue-gas desulfurization - an option used at many industrial plants. For the present, microcleaning technology is immature and does not represent the best alternative for the Army in reducing SOx.

43029 (CMHC–8707) **Fireplace air supplies and glass doors. A literature and equipment search.** Fugler, D. Canada Mortgage and Housing Corp., Ottawa, ON (Canada). 1987. 16p. (CE–02711). Available from Canada Mortgage and Housing Corporation, Annex Bldg., 628 Montreal Rd., Ottawa, ON, CAN K1A 0P7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The traditional open fireplace not only is likely to spill smoke into the house air, but also often acts as the biggest exhaust device in the house, causing the backdrafting or spillage of the furnace and other appliances. The most common suggested solutions is to isolate the fire air from the air in the house by installing glass doors and a fresh air intake from the outside. This paper describes a literature and equipment search which attempted to establish how the glass doors and fresh air intakes are specified and designed to meet this objective. The search through codes, standards, research reports, and miscellaneous articles proves that there is growing awareness of the need for fireplace air separation from house air. Sizing and location of the fresh air intakes, as specified by code or the manufacturers, appears rudimentary. The effect of the designs in keeping fireplace and house air separate, and the safety of these designs under various types of weather, house depressurization, and fireplace construction, have yet to be established. This way require extensive laboratory testing.

43030 (DGMK–359) **Evaluation of oil fired boilers with condensation of combustion water.** Burrlein, V.; Wulf, H.J.; Ewers, H.; Larsen, H. Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.); Deutsche BP Benzin und Petroleum A.G., Hamburg (Germany, F.R.); Deutsche Shell A.G., Hamburg (Germany, F.R.). Jul 1987. 30p. (In German). Available from Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.).

The report summarizes the performance evaluation of oil fired boilers for home heating with condensation of combustion water, as investigated in two research laboratories. Detailed results of the investigations are given as attachment. Important results were: Flue gas condensates contained only traces of metals, longer contact periods however resulted in metal corrosion of heat exchanger surfaces. Metal contents of condensates were within the current limits of waste water regulations. Only up to 5% of the sulphur content of the distillate heating oil was transferred into the condensate. The pH-value was in the range of 1,7 to 2,8. (orig.) With 8 tabs.

43031 (ETDE-mf–9910993) **Fibrous insulating materials in industrial furnaces - simulated calculations. Final report.** Verein Deutscher Eisenhuettenleute, Betriebsforschungsinstitut (BFI). Bericht. Schulte, M.; Klima, R. Betriebsforschungsinstitut VDEh-Institut fuer Angewandte Forschung G.m.b.H., Duesseldorf (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Sep 1986. 98p. (In German). Contract BMFT 03E-8273-A. Order Number DE89910993/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; NTIS (US Sales Only), PC A05/MF A01.

Details are given on simulated calculations helping to systematically analyze the influence of walls on the energy consumption of furnaces. Among the furnaces referred to are continuous furnaces (pusher, walking beam, and rotary hearth furnaces), and discontinuous furnaces (bogie hearth, batch, and pit furnaces). Explanations concerning the energy economic evaluation of industrial furnaces are followed by simulated calculations and the results obtained for fibrous insulating materials to be used in the furnaces described. Energy conservation as the result of an improved thermal insulation determines payback periods which are a measure of the economic efficiency of thermal insulation. (HWJ).

43032 (PB–89-864433/XAB) **Pulse combustion: devices and applications. January 1970-June 1989 (Citations from the US Patent data base). Report for January 1970-June 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 39p. Available from NTISPC N01/MF N01.

Supersedes PB–87-855615.

This bibliography contains citations of selected patents concerning pulse-combustion techniques, apparatus, and applications. Pulse combustion devices for burners, furnaces, boilers, ignition and fuel control, heating and drying systems, heat exchangers, and exhaust and noise reduction are presented. Applications for industrial, commercial, and residential space and water heating are considered. (This updated bibliography contains 60 citations, 17 of which are new entries to the previous edition.)

43033 (SC–8708) **Modifications and refinement of the computer model "wood burning simulator".** Swinton, M.C.; Sinha,

R.P.; Haysom, J.C. Scanda Consultants Ltd., Ottawa, ON (Canada). 1987. 124p. (CE–02712). Available from Canada Mortgage and Housing Corporation, Annex Bldg., 628 Montreal Rd., Ottawa, ON, CAN K1A 0P7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The characteristics of wood burning and its relative fireplace designs were investigated by refining and calibrating the wood burning simulation computer model. The investigation comprised a review of the relevant literature, a review of the applicable codes and standards, modifications in the computer model to allow it to model fireplace wood burning for a number of fireplace configurations, the generation of field data on the performance of a fireplace, calibration of the modifications to the computer model using data generated in field tests on open fireplaces, use of the computer model to illustrate its abilities, and incorporation in it of user-friendly features to improve the accessibility and usefulness of the program. The model was successfully refined and calibrated so that the main characteristics of wood burning and the performance of various fireplace enclosures can be simulated with some confidence. This work has underlined some of the aerodynamics and thermal design concerns that arise from introducing doors and a dedicated combustion air intake to a fireplace; although this combination can be a remedy against the depressurization of a house by its fireplace, it introduces several other ways in which the fireplace can be a hazard. Difficulties in calibrating the model have underlined the complexity of simulating a wood fire. 7 refs., 26 figs.

43034 (STEV-FBT–89-14) **Sulfur capture in fluidized bed boilers - the effect of combustion.** Lyngfelt, A.; Leckner, B. Statens Energiverk, Stockholm (Sweden). 1987. 13p. (CONF-8709456–1: Project leader conferece at STEV, Stockholm (Sweden), 24 Sep 1987). Order Number DE89902389/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The influence of temperature on sulphur capture by lime was studied in the 16 MW fluidized bed boiler at Chalmers. The test was designed to give information on the temperature behavior of sulphur capture in a fluidized bed. The investigation was performed as follows: A 'zero-test' giving the temperature dependence of SO_2 emissions prior to lime addition. The fluidized bed in this condition consisted mostly of silica sand. The sulphur content of the bed material was low, indicating that little or no $CaSO_4$ was present. 'Temperature dependence tests' showing the sulphur capture at various temperature with a constant addition of lime. The Ca/S molar ratio for the 'high temperature' test reported below was 1.5. These tests continued for eleven day and involved a substitution of bed material for lime and calcium sulfate. A 'sulphur capture decay' test showing the decrease in sulphur capture for a period of 58 hours after lime addition was stopped. The 'decay' test followed the 'temperature dependence test' so that the bed was 'loaded' with $CaSO_4$ and CaO. The sulphur content of the bed material during the 'decay test' was approximately 7% corresponding to 30% calcium sulfate, indicating a presence of 3000 kg $CaSO_4$.

43035 (WPLA–327G431) **An assessment of airflow measurement techniques.** Barker, G. London (W.P.) and Associates Ltd., Niagara Falls, ON (Canada). 1986. 75p. (CE–02625). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The objectives of this study were to establish the sources of recurring problems with the measurement of air flow to utility boilers, and to provide basic information on existing and developing conventional and unconventional methods of air flow measurement. The information gathered in the study will be used in the preparation of a Canadian Electrical Association standard for air flow measurement to be used by utilities and boiler and instrument suppliers as a common basis for design and bidding. 21 refs., 1 tab.

4220 Underground Engineering

Refer also to citation(s) 42184, 42185, 42186

4230 Marine Engineering

Refer also to citation(s) 42601, 42602

43036 (COGLA–8702) **Preferred orientation and displacement evacuation system.** Leafloor, F.C.; Yeo, G.B. Canada Oil and Las Lands Administration, Ottawa, ON (Canada). 1987. 179p. (CE–02678). Available from Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Field trials were conducted on the PROD evaluation system (PROD). The PROD evaluation system is a reponse to a recommendation of the Royal Commission on the Ocean Ranger Disaster, which stated that utmost priority be given to the development of safe evacuation systems for foreseeable emergency and storm conditions. An essential consideration was to ensure that a lifeboat clear the rig structure during lowering and, upon release, escape from the vicinity of the rig. The sea trials are described in this report. Phase 1 and 2 comprised 40 launches of a remote-controlled 22-persons conventional lifeboat with PROD adaptations, and including crane recovery of the lifeboat. Phase 3 comprised 26 launches and recoveries of 60-persons lifeboats and 3 towing tests. Extensive video coverage of the tests will help to increase the confidence of the future users of this system. During phases 1 and 3, a computerized data collection system was used, including strain gauges to measure forces within the PROD boom, and accelerometers within the lifeboat. It is recommended that this system be installed in order to enhance rig evacuation capability. Further sea trials of towing and recovering lifeboats should be carried out. 15 refs., 37 figs., 12 tabs.

43037 (COGLA–8702A) **Preferred orientation and displacement evacuation system. Appendix.** Leafloor, F.C.; Yeo, G.B. Canada Oil and Las Lands Administration, Ottawa, ON (Canada). 1987. 128p. (CE–02677). Available from Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Field trials were conducted on the Preferred Orientation and Displacement System (PROD). The PROD system is a response to a recommendation of the Royal Commission on the Ocean Ranger disaster, which stated that utmost priority be given to the development of safe evacuation systems for foreseeable emergency and storm conditions. An essential consideration was to ensure that a lifeboat clear the rig structure during lowering and, upon release, escape from the vicinity of the rig. This second volume gives the chronology of the project, the list of components and auxiliary components of the PROD system, a description of the data acquisition systems and simulation systems, a graphic representation of all sea trials, and a description of the lifeboat recovery and towing systems. 5 refs., 148 figs., 13 tabs.

43038 (DNV/C–48SZ23304-6-5006) **Variability and occurence of offshore winds and waves. Final report.** Maes, M.A. Det Norske Veritas (Canada) Ltd. (Canada). 1986. 122p. (CE–02679). Available from Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This study consists of two parts. In Part 1, the oceanographic and meteorological databases currently available at the Canadian Climate Centre of Environment Canada are used to produce plots for the coefficient of variation of annual and monthly environmental loads. This parameter is extremely important for the calculation of design risks and is linked to the selection of the environmental load factor in design codes. Extreme wind loads, and wave loads induced by both drag and inertia, are examined for the East Coast, the West Coast, and the Beaufort Sea. In Part 2, the arrival rate of severe storms in the Eastern Canadian offshore is studied. Both wind speed and wave height are used as severity criteria. The hypothesis that the annual and monthly occurrence of storms can be modelled as a Poisson process is examined. The implications of the

applicability of such a model to the calculation of design wave height are discussed. 24 refs., 129 figs., 11 tabs.

43039 (NEI-NO–90) **Experiences with offshore instrumentation.** Norske Sivilingenioerers Forening, Oslo (Norway). 1986. 308p. (In Norwegian). (CONF-8601153–: Experiences with offshore instrumentation, Geilo (Norway), 29-31 Jan 1986). Order Number DE89902379/JAW. Available from NTIS (US Sales Only), PC A14.

Course on experiences with offshore instrumentation, Jan 29-31, 1986, Geilo, Norway.

The collected papers given at a course concerns the experiences gained from the various methods used in the fields of navigation, bathymetry, shallow gas surveying, and pipeline planning on the Norwegian continental shelf. Separate abstracts are prepared for ten papers. 86 figs., 8 refs.

4240 Pollution Control Equipment

Refer also to citation(s) 42225

43040 Combined removal of SO_2, NO_x, and fly ash from simulated flue gas using pulsed streamer corona. Clements, J.S. (9521249); Mizuno, A.; Finney, W.C.; Davis, R.H. *IEEE (Institue of Electrical and Electronics Engineers) Transactions on Industry Applications (USA),* 25: 62-69 (Jan 1989).

A pulse-energized electron reactor which utilizes pulsed streamer corona has been developed for the combined removal of SO_2, NO_x, and particles from effluent gases. In the pulse-energized electron reactor process, fast-rising narrow high-voltage pulses are superimposed on a dc-bias voltage and applied to a nonuniform electric field geometry to generate pulsed streamer corona. The pulsed streamer corona produces energetic free electrons, which dissociate gas molecules, forming radicals. These radicals cause chemical reactions that convert SO_2 and NO_x into acid mists and/or solids, which can be removed from the gas stream by conventional means. The pulsed streamer corona also produces ions, and between pulses the ions charge the fly-ash particles, which are then collected by the dc-bias field. In pulse-energized electron reactor performance tests on a humid air stream with an initial SO_2 concentration of 1000 ppm, more than 90 percent of the SO_2 was removed with an advantageously small power requirement. Combined treatment performance was demonstrated by introducing high-resistivity fly-ash into the gas stream. The fly-ash collection efficiency of the pulse-energized electron reactor was significantly better than that of a conventional dc wire-cylinder electrostatic precipitator when the electrodes of both were covered with a high-resistivity layer.

4250 Power Cycles

43041 An example of the manipulation of effective vapor pressure curves by thermodynamic cycles. Radermacher, R. (3946000). *Journal of Engineering for Gas Turbines and Power (USA),* 110(4): 647-651 (Oct 1988).

The performance of a two-stage Rankine cycle employing a working fluid mixture and solution circuits has been computed with reference to heat pump applications. Its performance is compared to the single-stage version of this cycle and of operating with pure refrigerants. It is found that the two-stage cycle operates along an effective vapor pressure curve of very flat slope, resulting in pressure ratios that are reduced to about one third compared to conventional cycles. For large temperature differences between heat sink and source the Coefficient of Performance (COP) can be increased by up to 50 percent.

43 PARTICLE ACCELERATORS

Refer also to citation(s) 42074, 43803

43042 (AECL–9501) **Multiple scattering of electron beam in linac window.** Lee-Whiting, G.E. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Jun 1987. 32p. Order Number DE89635425/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The combined effects of the multiple scattering of an electron beam in an accelerator window and in the air between the window and a product being irradiated are calculated in the Gaussian approximation. A method of averaging over the initial distributions of displacement and direction of the beam is formulated. Several approximate treatments, appropriate to different degrees of focusing, are developed for the required phase-space integrations. Particular attention is given to finding computational methods speedy enough for incorporation in a computer program to be used for exploratory design.

43043 (KEK-PR–88-2) **KENS report-7, 1987/88.** Watanabe, N.; Arai, M.; Asano, H.; Endoh, Y. (eds.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). 1988. 168p. Order Number DE89906588/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

The present issue summarizes the research activities performed at the KENS Facility from September, 1986 to March, 1988. In this issue, the style of the report is improved a little bit to the concise from with two columns. In this period, proton beam intensity was gradually increased, and a beam intensity of 2×10^{12} protons per pulse seemed to come within range. A new data acquisition and processing system was introduced last year, and the construction of a chopper spectrometer INC progressed. The total number of the papers published was about 250. This is the third year of the UK-Japan collaboration on neutron scattering study, and the construction of a chopper spectrometer MARI provided by KEK will be completed in 1990 on the ISIS in Rutherford Appleton Laboratory. A lot of the experiments on high Tc superconductors were proposed, and mostly carried out as a part of B_1 experiments. The future program of the pulsed spallation neutron source KENS-2 was included in the Japanese Hadron Facility Project as an important part of four major fields. The project is now under examination by the government. In the last chapter of this report, the short reports on high intensity proton accelerators are compiled for future reference. The reports in the fields of instrumentation, neutron scattering, structures of liquid and glass, magnetic structure and excitation and others are collected. (K.I.).

4301 Design, Development, and Operation

Refer also to citation(s) 42905, 43068, 43090, 43091, 43133, 43163, 43164, 43782, 44230, 44233, 44308

43044 (ANL/APS-TM–3, pp. 5-22) **Characteristics of the advanced photon source and comparison with existing synchrotron facilities.** Rivers, M.L. Argonne National Lab., IL (USA). Apr 1988. (CONF-880194–: Workshop on synchrotron X-ray sources and new opportunities in the earth sciences, 18-20 Jan 1988). In *Synchrotron x-ray sources and new opportunities in the earth sciences: Workshop report.* Order Number DE88009858/JAW. Available from NTIS, PC A07/MF A01.

The Advanced Photon Source will provide significant increases in photon intensity over existing synchrotron sources. Undulators will increase the flux in the 3-40 keV range by several orders of magnitude with relatively narrow energy bandwidths. Wigglers and bending magnets will provide much higher flux in the energy range above 40 keV with a smooth energy spectrum. The details of the spectral characteristics of the APS source are discussed, and compared with those of existing US hard x-ray synchrotron storage rings.

43045 Application of accelerators in research and industry '88: Proceedings: Part 1. Duggan, J.L.; Morgan, I.L. (eds.). 734p. North-Holland Physics Publishing, Amsterdam, The Netherlands (1989). Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER40455. From 10. international conference on the application of accelerators in research and industry; Denton, TX (USA); 7-9 Nov 1988.

This book contains papers from the conference on the application of accelerators in research and industry. Topics covered in this volume are: atomic physics and related phenomena; synchrotron experiments; nuclear physics and astrophysics; ion implantation, semiconductors, materials modification; and PIXIE microprobe. (FI)

43046 Application of accelerators in research and industry '88: Proceedings: Part 2. Duggan, J.L.; Morgan, I.L. (eds.). 724p.

North-Holland Physics Publishing, Amsterdam, The Netherlands (1989). Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER40455. From 10. international conference on the application of accelerators in research and industry; Denton, TX (USA); 7-9 Nov 1988.

This book contains papers from the conference on the application of accelerators in research and industry. Topics covered in this volume are: Materials analysis facilities, mass spectroscopy, Rutherford backscattering and channeling nuclear reaction analysis, resonant ionization spectroscopy; accelerator technology, accelerator facilities, RFQ beams, diagnostics, computer control, neutral beams, magnets, ion sources, free electron lasers, components calculations; accelerator production of radioisotopes for medical applications, targets for nuclear research; Radiation processing, irrodiation facilities, high dose calibration, ion optics; activation analysis, detectors, spectrometers, calibration, dose measurements, upsets; Radiography; and Radiation therapy, medical and biomedical application, neurosurgery with ion beams.(FI)

43047 (INIS-mf–11512) **Saskatchewan Accelerator Laboratory. Annual report 1986.** Saskatchewan Univ., Saskatoon, SK (Canada). Saskatchewan Accelerator Lab. 1986. 93p. Order Number DE89635426/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

We have now completed the third year of the upgrading project to convert our conventional linear accelerator to a 300 MeV CW electron beam facility. The original Natural Sciences and Engineering Research Council (NSERC) grant in 1983 was for the following items: an energy compressor to improve the spectrum from the linac, a pulse stretcher ring to give ~ 100% duty cycle, and a modern QDD spectrometer for efficient data taking. The status of all these items and other equipment funded for experiments is discussed in the text of this report. More details on the parameters of the various components may be found in previous annual reports (1984 and 1985). The 1984 report also describes the administrative structure of the project and how the performance of the laboratory is evaluated. Part of that supervisory structure is NSERC's Saskatchewan Advisory Committee. That committee visited the laboratory on 10-11 April 1986 and sent a satisfactory report to the presidents of NSERC and of the University of Saskatchewan. One more visit of this committee is expected at the completion of the project.

43048 (JAERI-M–89-016) **Takasaki Ion beam Implanter (TIBI). Operation and experiments.** Aoki, Yasushi; Nagai, Siro. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1989. 49p. (In Japanese). Order Number DE89906464/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

TIBI (Takasaki Ion Beam Implanter) was installed at Takasaki Radiation Chemistry Research Establishment of JAERI in October 1987 with principal purpose to carry out preliminary studies preceding to the research program for Advanced Radiation Technology (ART) which is now in progress. This implanter can generates various ions from both gaseous and solid materials and accelerate them up to 200 keV. In the irradiation chamber attached to it, samples can be ion-implanted in high vacuum at - 196degC and at different temperature from room temperature to 1250 degC. This report describes in the first place the circumstances until the installation, the outline, the operational procedure, and the safety systems of TIBI and then our results of test for production and acceleration of ions and of preliminary experiments using this implanter. Finally, a view is given of ion implantation to organic polymers. (author).

43049 (LAPP-EXP–88-13) **Superconducting radiofrequency e^+e^- linear collider for bottom quark and nuclear physics studies.** Coignet, G. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. Jun 1988. 26p. (CONF-8804290–: International conference on advanced technology and particle physics; 16. international meeting on fundamental physics on CP non conservation and B physics, Como (Italy), 12-17 Jun 1988; 25-29 apr 1988; CONF-8806235–). Order Number DE89791990/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The design of an accelerator complex based on recirculated linacs is presented. It could be used as a b-antib hadron factory and simultaneously it could provide nearly continuous beams for Nuclear Physics studies. The expected performances of this accelerator are given. The main components and the associated developments are mentioned. The characteristics of the associated detector requested to perform an original b-antib physics program are also listed. Finally, possible extensions offered by the accelerator complex are presented.

43050 (LBL–25962) **184-inch Synchrocyclotron decommissioning.** Reimers, D.; Haley, J.; Hampton, G. Lawrence Berkeley Lab., CA (USA). Mar 1989. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–244: 13. particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989). Order Number DE89016344/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

SYNCHROCYCLOTRONS/decommissioning; SYNCHROCYCLOTRONS; DECOMMISSIONING; SAFETY; WASTES

43051 (PB–89-179311/XAB) **Superconducting structures for the acceleration of heavy ions up to 0.5c. Final report.** Delayen, J.R. Applied Superconductivity, Inc., Altadena, CA (USA). Oct 1986. 46p. Available from NTIS, PC A03/MF A01.

The higher the velocity of the ions a particular structure is designed to accelerate, the larger the number of that structure will be installed in an accelerator. Therefore, as the velocity increases it becomes more and more important to optimize the design of the resonator to provide the highest voltage gain with the smallest combination of operating and construction costs. Researchers have developed a set of procedures that allow optimization of the design with respect to the actual properties of superconducting surfaces. These procedures have been found to be very accurate in predicting the electromagnetic properties of low-velocity resonators. They also produce an optimized design, where the various loss mechanisms are balanced, by making use of the practical nonlinear properties of superconducting surfaces.

43052 **Superconducting magnet system.** Dahl, P. (Brookhaven National Laboratory, Upton, NY 11973 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA)*, 184(2): 1327-1376 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

The superconducting magnet system for the superconducting super collider is described. A design scheme considering magnet load line, central field and saturation, multipoles, inductance, stored energy and leakage field, and superconductor magnetization is presented. The niobium titanium superconductor is described coils, iron yoke and helium containment, beam tube assembly, quench protection features, the cyrostat, magnet testing, the quadrapoles, and other magnets are described.

43053 **Radio-frequency acceleration.** Puglisi, M. (Sincrotrone Trieste (IT)). *AIP (American Institute of Physics) Conference Proceedings (USA)*, 184(2): 1393-1476 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

In contrast to the early days of cyclic and linear RF accelerators, modern high beam currents and performance parameters require very sophisticated and expensive RF accelerating systems. This work is a schematic presentation of current RF acceleration technology. Because of time limitations this treatment will be based simply on drawings and schematic comments. (AIP)

43054 **Overview of the advanced photon source.** Moncton, D. E. (Advanced Photon Source, Argonne National Laboratory, Argonne, Illinois 60439 (US)); Crosbie, E.; Shenoy, G. K. *Review of Scientific Instruments (USA)*, 60(7): 1403-1405 (Jul 1989).

The Advanced Photon Source planned for construction at Argonne National Laboratory is based on a low-emittance storage-ring operated at 7 GeV and capable of providing tunable undulator radiation from 4 to 40 keV (using the first and the third harmonics). A technical description of the accelerator facility and the storage ring is presented in this overview, along with a brief summary of the characteristics of radiation that will be available from the insertion devices. Various plans for user access to this national user facility are also given.

43055 Plasma acceleration of particle beams. Katsouleas, T. (University of California, Los Angeles, CA 90024 (US)); Dawson, J. M. *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1798-1829 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

Plasmas, being fully ionized gases, are immune from electrical breakdown and so can support ultra-high accelerating fields (order GeV/cm) in the form of relativistic plasma waves. Several schemes to excite these waves and use them for particle acceleration are reviewed in this article. These include the beat wave accelerator (laser driven) and the plasma wakefield transformer (particle beam driven). In addition, the possible use of plasmas to provide strong final focusing of beams (the plasma lens) is described.

43056 Introduction. Edwards, D. A. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, IL 60510 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1830-1844 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

A brief overview of major component design decisions for the Fermilab Tevatron due to available technology are presented. Components of the Tevatron discussed here are the superconducting magnets, cryogenics, the power system and quench protection, and the vacuum system. Other decisions concerning the development of the fixed-target design and the transformation to collider are considered. (AIP)

43057 Detection and compensation of transverse resonances. Gerig, R. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, IL 60510 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1928-1940 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

This article considers the techniques used to identify and compensate nonlinear errors in the magnets of a circular accelerator. The design of a corrections system and the way in which it is used are also described. Finally, a simulation is described in which the emphasis is on reproducing the results that are observed while measuring and compensating resonance lines. We have found that correction of the resonance lines in the simulation is successful whereas compensation in the real machine is only partially successful. Attempts are being made to enhance the model in order to better simulate the behavior of the Main Ring of the Fermilab Tevatron. (AIP)

43058 Longitudinal phase space in circular accelerators. Martin, P. S. (Fermi National Accelerator Laboratory, Batavia, IL 60510 (US)); Ohnuma, S. *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1941-1968 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

This paper is a primer on the longitudinal phase space in circular accelerators which was presented at the 1987 U.S. Particle Accelerator School at Fermilab. First definitions are given, then beam and bucket parameters are discussed and the two frequency case and bunch coalescing are reviewed. (AIP)

43059 Design and operation of the quench protection system for the fermilab tevatron. Martin, P. S. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, IL 60510 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 2073-2097 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

This is a discussion about the quench protection system for the Main Tevatron superconducting magnet system. We present a brief discussion of the basic properties of superconductors and the phenomenon of quench propagation. Operational characteristics of quenching phenomenon in the Tevatron magnets are presented. (AIP)

43060 Science in the age of accelerators. Perl, M. L. (Stanford Linear Accelerator Center, Stanford, California 94305 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 2098-2115 (5 Apr 1989). DOE Contract AC03-76SF00515. (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

A brief illustration of how science has developed along with how accelerator technology and accelerators have developed and have become a part of science is presented. The author has traced the intertwining of the private and public worlds of science with the coming of age of particles accelerators. (AIP)

43061 Accelerator projects, worldwide. Teng, L. C. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 2116-2126 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

In this paper there is a description of worldwide accelerator projects in two principal categories, i.e., high energy colliders (the pursuit of high energies or small dimensions for particle physics studies is the initial and basic motivation for the development of accelerators) and high intensity, medium energy accelerators (machines of this category are useful for both particle and nucleon physics research). (AIP)

43062 Induction accelerators and free-electron lasers at LLNL. Briggs, R. J. (Lawrence Livermore National Laboratory, Livermore, California 94550 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 2183-2207 (5 Apr 1989). DOE Contract W-7405-ENG-48. (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

Linear induction accelerators have been developed to produce pulses of charged particles at voltages exceeding the capabilities of single-stage, diode-type accelerators and at currents too high for rf accelerators. In principle, one can accelerate charged particles to arbitrarily high voltages using a multi-stage induction machine. The advent of magnetic pulse power systems makes sustained operation at high repetition rates practical, and high-average-power capability is very likely to open up many new applications of induction machines.

43063 Synchrotron radiation A general overview and a review of storage rings, research facilities, and insertion devices. Winick, H. (Stanford Synchrotron Radiation Laboratory, Stanford, CA 94309 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 2138-2182 (5 Apr 1989). DOE Contract AC03-82ER13000. (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

Synchrotron radiation, the electromagnetic radiation given off by electrons in circular motion, is revolutionizing many branches of science and technology by offering beams of vacuum ultraviolet light and x rays of immense flux and brightness. In the past decade there has been an explosion of interest in these applications leading activity to construct new research facilities based on advanced storage rings and insertion device sources. Applications include basic and applied research in biology, chemistry, medicine, and physics plus many areas of technology. In this article we present a general overview of the field of synchrotron radiation research, its history, the present status and future prospects of storage rings and research facilities, and the development of wiggler and undulator insertion devices as sources of synchrotron radiation.

43064 Supercollider physics. Quigg, C. (SSC Central Design Group, Lawrence Berkeley Laboratory, Berkeley, California 94720 USA (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 2255-2279 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

My order of business will be to summarize the microscopic description to which we have come in the past twenty years. I will review the evidence for quarks and leptons as fundamental constituents and explain the strategy of gauge theories of the fundamental interactions. Next, I will discuss questions the Standard Model raises but cannot answer. We can define a frontier where out current understanding ceases to make senese, where the clues that will lead us to a more satisfying description of nature will have to be

found. That frontier lies at energies of about 10^{12} electron volts for collisions among the fundamental constituents. The instrument of choice for reaching this new energy scale is a high-energy, high-luminosity, proton-proton collider. I will conclude by summarizing the status of the American project known as the Superconducting Super Collider, or SSC. (AIP)

43065 Particle accelerators and discoveries in elementary particle physics. Jones, L. W. (Randall Laboratory of Physics, University of Michigan, Ann Arbor, Michigan 48109-1120 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA)*, 184(2): 2280-2299 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

Some discoveries in elementary particle physics are recounted from personal and historical perspective with particular reference to their interaction with particle accelerators. The particle examples chosen include the ψ/J, the Υ, and the study of nucleon constituents with inelastic electron scattering. Precursors experiments are cited together with the better known discoveries.

43066 Progress on next generation linear colliders. Ruth, R. D. (Stanford Linear Accelerator Center, Stanford University, Stanford, CA 94305 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA)*, 184(2): 2208-2226 (5 Apr 1989). DOE Contract AC03-76SF00515. (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

The purpose of this paper is to review progress in the U.S. towards a next generation linear collider. I will focus on reviewing the issues on progress on a next generation linear collider with the following general parameters: energy, 0.5–1.0 TeV in center-of-mass; luminosity, 10^{33}–10^{34} cm^{-2} sec^{-1}; length, each linac$\lesssim$3 km; power, $\lesssim$100 MW per Linac; technology, must be realizable by 1990–92. (AIP)

4302 Beam Dynamics, Field Calculations, and Ion Optics

Refer also to citation(s) 43053, 43058, 44019, 44204, 44222, 44304

43067 (BNL–42954) **Tangent map analysis of the beam-beam interaction.** Lee, S.Y.; Tepikian, S. Brookhaven National Lab., Upton, NY (USA). 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890594–4: 3. advanced inertial confinement fusion accelerator beam dynamics workshop: beam-beam effects in circular colliders, Novosibirsk (USSR), 20 May - 3 jun 1989). Order Number DE89015857/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We studied the tangent map of the beam-beam interaction and found no evidence of beam-beam instability for $\epsilon = 0.04$. Tracking study with tune modulation shows however large emittance growth due to the sum resonances. The emittance growth is due to the multiple crossing of the sum resonances. 12 refs., 7 figs.

43068 (CONF-881049–75) **NIST–Los Alamos racetrack microtron status.** Wilson, M.A.; Ayres, R.L.; Cutler, R.I.; Debenham, P.H.; Lindstrom, E.R.; Mohr, D.L.; Penner, S.; Rose, J.E.; Young, L.M. National Inst. of Standards and Technology, Gaithersburg, MD (USA); Los Alamos National Lab., NM (USA). 1988. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AI01-87ER40332;W-7405-ENG-36. From 14. linear accelerator conference (LINAC-14); 3-7 Oct 1988. Order Number DE89016083/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The NIST-Los Alamos Racetrack Microtron (RTM) is designed to deliver a low-emittance electron beam of up to 0.5 mA cw over an energy range of 17 MeV to 185 MeV. Fed by a 5 MeV injector, the RTM contains two 180° end magnets that recirculate the beam up to 15 times through a 12 MeV RF linac. The linac, which operates in a standing-wave mode at 2380 MHz, has been tested to nearly full RF power. At present, the injector has undergone beam tests, and the beam transport system is complete through the 12 MeV linac. A temporary beam line has been installed at the exit of one end magnet to measure the beam energy, energy spread, and emittance after one pass through the accelerator. Preliminary results indicate that the accelerated beam energy spread and emittance are within design goals. 4 refs., 7 figs.

43069 (FNAL/C–89/137) **Finite difference time domain modelling of particle accelerators.** Jurgens, T.G.; Harfoush, F.A. Fermi National Accelerator Lab., Batavia, IL (USA). Mar 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890335–237: 13. particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989). Order Number DE89015242/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Finite Difference Time Domain (FDTD) modelling has been successfully applied to a wide variety of electromagnetic scattering and interaction problems for many years. Here the method is extended to incorporate the modelling of wake fields in particle accelerators. Algorithmic comparisons are made to existing wake field codes, such as MAFIA T3. 9 refs., 7 figs.

43070 (FNAL-TM–1612) **An algorithm to calculate the beam momentum distribution from flying wire profiles.** Wang, X.Q. Fermi National Accelerator Lab., Batavia, IL (USA). 27 Jul 1989. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. Order Number DE89015587/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Horizontal flying wire measurements give beam profiles from which information about the beam momentum distribution and betatron distribution can be extracted. When calculating these beam characteristics in the past, for the matter of simplicity, the beam has been assumed Gaussian. For beam profiles which may not be Gaussian, an algorithm to obtain the general beam momentum distribution is developed using the Fourier transform to the beam profiles. Since the profile is the convolution of the momentum distribution and the betatron distribution, using a Fourier transform method makes calculations easier. 6 figs.

43071 (INIS-SU–103/A, pp. 9-11) **On the nonlinear theory of electromagnetic wave scattering on dense relativistic electron beams.** Kuzelev, M.V. (AN SSSR, Moscow (USSR). Inst. Obshchej Fiziki); Panin, V.A.; Plotnikov, A.P.; Rukhadze, A.A. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Quantum radiophysics. Collection.* Order Number DE89012203/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 12.

Nonlinear stabilization of three-wave processes in systems with dense relativistic direct beams is studied. Using expansion of constitutive equations in terms of trajectory and electron pulse perturbations analytical solutions for interacting wave amplitudes and instability saturation time are derived. Decay with increased frequency and explosion process are considered. 10 refs.

43072 (INIS-SU–103/A, pp. 12-14) **On the mechanism of nonlinear saturation of the kinetic beam instability under anomalous Doppler effect.** Kuzelev, M.V. (AN SSSR, Moscow (USSR). Inst. Obshchej Fiziki); Romanov, R.V.; Rukhadze, A.A. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Quantum radiophysics. Collection.* Order Number DE89012203/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 12.

Analytical nonlinear theory of the wave radiation by a hot direct electron beam in a constant external magnetic field with instability under anomalous Doppler effect is presented. The nature of instability stabilization mechanism is stated, maximum wave amplitudes are determined, their dynamics is studied. 4 refs.; 2 figs.

43073 (INIS-SU–103/A, pp. 56-58) **Dynamics of a REB in an external magnetic field.** Nauryzbaev, A.E. (AN SSSR, Moscow (USSR). Inst. Obshchej Fiziki). AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Quantum radiophysics. Collection.* Order Number DE89012203/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 12.

Results of numerical simulation of quasistationary REB dynamics in a solid gas, the external longitudinal magnetic field being given, are presented. Radial dynamics of axially-symmetric quasistationary

self-focusing REB in a circular tube filled with solid gas in totally defined by intrinsic self-consistent and external longitudinal magnetic fields and by electron scattering in a gas. In case of a strong magnetic field, high isotropic beam heating without its sufficient spread is observed. For a case of strong electron scattering the calculated values of radius and REB transverse temperature variations, depending on the propagation distance, are obtained. Consideration corresponds to REB injection from the magnetized cathode. The obtained results are compared with solution of an envelope equation. 8 refs.; 2 figs.

43074 (LBL–25988) **Emittance at the superHILAC and the Bevalac transfer line.** Krebs, G..F.; Kalnins, J.G.; Abinante, M.S.; Alonso, J.R.; Feinberg, B.; Fowler, K.; Guggemos, J.; Staples, J.; Thatcher, R.; Zajec, E. Lawrence Berkeley Lab., CA (USA). Mar 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–238: 13. particle accelerator conference, 20-23 Mar 1989). Order Number DE89015336/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The SuperHILAC (SHILAC) accelerator serves as a heavy-ion injector to the Lawrence Berkeley Laboratory's Bevalac via a 260 m transport line. Since the acceptance, and hence the final extracted beam intensity of the Bevalac is very sensitive to the emittance and dispersion of the beam at injection, a program was undertaken to accurately characterize these parameters under a variety of operating conditions. 7 figs.

43075 (LBL–27351) **A symplectic coherent beam-beam model.** Furman, M.A. Lawrence Berkeley Lab., CA (USA). May 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890594–3: 3. advanced inertial confinement fusion accelerator beam dynamics workshop: beam-beam effects in circular colliders, 20 May - 3 jun 1989). Order Number DE89015386/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We consider a simple one-dimensional model to study the effects of the beam-beam force on the coherent dynamics of colliding beams. The key ingredient is a linearized beam-beam kick. We study only the quadrupole modes, with the dynamical variables being the 2nd-order moments of the canonical variables q, p. Our model is self-consistent in the sense that no higher order moments are generated by the linearized beam-beam kicks, and that the only source of violation of symplecticity is the radiation. We discuss the round beam case only, in which vertical and horizontal quantities are assumed to be equal (though they may be different in the two beams). Depending on the values of the tune and beam intensity, we observe steady states in which otherwise identical bunches have sizes that are equal, or unequal, or periodic, or behave chaotically from turn to turn. Possible implications of luminosity saturation with increasing beam intensity are discussed. Finally, we present some preliminary applications to an asymmetric collider. 8 refs., 8 figs.

43076 (NIIEFA-P-E–0768) **Damping radial betatron oscillations of electrons in the Erevan synchrotron.** Belov, V.P.; Makarov, A.A.; Martirosyan, G.A. and others. Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR). 1988. 33p. (In Russian). Order Number DE89635428/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Effect of raiation and its quantum fluctuations on particle dynamics in the Erevan synchrotron at different modes of operation of synchrotron power supply system and different extracted beam energies is considered. Problems of compensation of radial oscillations build-up: in the scattering field of low-aperture magnets of a damping device and in the working range of full-aperture permanent gradient magnets, are presented. Disturbances introduced by a damping device to particle dynamics are considered. The device manufacturing and set-up tolerances are formulated. 4 refs.; 2 figs.; 2 tabs.

43077 (ORNL/FTR–3322) **[Meeting of senior members of the CERN WA80 and NA35 collaborations, Frankfurt, W. Germany, and help write a joint letter of intent proposing a joint experiment to be performed when lead beams become available at CERN, Geneva, Switzerland, June 28–July 4, 1989]: Foreign trip report.** Plasil, F. Oak Ridge National Lab., TN (USA). 15 Jul 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015321/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler participated in a meeting of the senior members of the CERN WA80 and NA35 collaborations, held June 28–30, 1989, in Frankfurt, FRG. The purpose of the meeting was to produce a joint letter of intent, indicating a joint interest in proposing an experiment to be performed when beams of heavy projectiles, such as lead, become available at the CERN SPS. After several ups and downs, the two collaborations agreed to merge and agreed that the measurement of direct photons and tracking in a time-projection chamber (TPC) are to be the two principal goals of the new collaboration. A fairly detailed letter of intent was drafted. The traveler visited the WA80 and NA35 experiments at CERN. The WA80 experiment is in the process of being moved and/or modified. Measurements of the NA35 vertex magnet were made.

43078 (SLAC-PUB–5021) **Requirements and limitations on beam quality in synchrotron radiation sources.** Cornacchia, M. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1989. 21p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8904228–3: CERN accelerator school, Chester (UK), 6-13 Apr 1989). Order Number DE89013987/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The requirements and limitations of the third generation of synchrotron radiation facilities are reviewed. These machines are designed to emit radiation of very high intensity, extreme brightness, very short pulses, and laserlike coherence. These performance goals put severe requirements on the quality of the electron or positron beams. Phenomena affecting the injection process and the beam lifetime are discussed. Gas desorption by synchrotron radiation, collective effects (coupled bunch oscillations) and ion trapping (for an electron beam) play an important role. Low emittance lattices are more sensitive to quadrupole movements and at the same time, in order not to lose the benefits of high brilliance, require tighter tolerances on the allowed movement of the photon beam source. 22 refs., 9 figs.

43079 (UCRL–99782) **Optical Cerenkov measurements of emittance growth in the ATA beam under laser ion-guiding.** Chong, Y.P.; Deadrick, F.J.; Hirzel, D.G.; Kallman, J.S.; Lee, P.; Poulter, J.F.; Rivera, W.E.; Stephan, P.L.; Weir, J.T. Lawrence Livermore National Lab., CA (USA). 1989. 18p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. (CONF-890335–239: 13. particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989). Order Number DE89016656/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A new beam profile diagnostic using optical Cherenkov radiation from a quartz foil has been deployed at the Advanced Test Accelerator (ATA) at Lawrence Livermore National Laboratory. Quartz has been found to perform better than previously tested foils (titanium and Kapton) in terms of damage threshold. The emission intensity from quartz is over an order of magnitude brighter than that from graphite foil. Data were taken at the beginning, middle, and end of ATA, i.e., at 3.8 MeV (cell 15), 22.5 MeV (cell 90), and 43 MeV (11 m beyond the end). Profile measurements of the ion-focused beam showed emittance growth through the pulse. Double-Gaussian fits to the radial profile were often superior to single-Gaussian fits and showed that a large beam dominated the second half of the pulse. This was observed for currents of 1, 3, and 7 kA at the accelerator output and at cell 15 for the 3-kA case. The dependence of emittance growth on several parameters was studied. 7 figs.

43080 A study of heavy-ion beams during longitudinal compression using particle simulation. Ho, D.D.M. (Lawrence Livermore National Lab., CA (USA)); Brandon, S.T. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands)*, 278(1): 182-185 (15 May 1989). DOE Contract W-7405-ENG-48. (CONF-8806101–: International symposium on heavy ion inertial fusion, Darmstadt (Germany, F.R.), 28-30 Jun 1988).

Particle simulations show that during longitudinal compression there is little growth in beam longitudinal and transverse emittance. Both longitudinal and transverse temperatures follow adiabatic laws. The compressed beam has negligible longitudinal momentum

spread and therefore can satisfy stringent requirements for final focusing. (orig.).

43081 Development of 3D simulations for heavy-ion fusion beam transport and compression problems. Mark, J.W.K. (Lawrence Livermore National Lab., CA (USA)); Friedman, A.; Chang Chialie; Drobot, A.; Mankofsky, A.; Faltens, A. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 278(1): 186-190 (15 May 1989). DOE Contract W-7405-ENG-48. (CONF-8806101--: International symposium on heavy ion inertial fusion, Darmstadt (Germany, F.R.), 28-30 Jun 1988).

Longitudinal beam compression and the possibility of concurrent pulse shaping have been the subject of previous studies using analytical methods and 1D and 2D codes. Here we report on a code development effort to study 3D beam transport in quadrupoles and final compression of a drifting heavy-ion beam pulse. As part of this effort we are making improvements to the ARGUS particle-in-cell (PIC) code to investigate 3D effects of magnetic quadrupole beam transport. A system with magnetic-quadrupole focusing fields is realistically three-dimensional. Although magnetic quadrupoles are expected to be an integral part of much of the heavy-ion accelerator driver, the restrictions due to space-charge modifications of the beam are particularly acute during final compression and focusing, and so we concentrate on this stage. Our initial preliminary benchmarking runs are presented. (orig.).

43082 Transverse misalignments in a driver. Smith, L. (Lawrence Berkeley Lab., CA (USA)); Hahn, K. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 278(1): 191-193 (15 May 1989). DOE Contract AC03-76SF00098. (CONF-8806101--: International symposium on heavy ion inertial fusion, Darmstadt (Germany, F.R.), 28-30 Jun 1988).

The transverse errors of the beam lines are usually corrected by an appropriate feedback to bring the beam back on axis. In an induction linac, however, the head and tail of the bunch differ substantially in momentum at a given lens location. As a result, the correction has to be time-dependent. Such a correction becomes increasingly difficult as the beam energy increases and the time duration of the bunch decreases. As a step towards an understanding of the problem, we have analyzed the extreme case of applying no correction. Since the lattice configuration changes and the transverse oscillations are damped as the ions are accelerated, the rms amplitude does not increase simply as the square root of the number of periods, as one would expect for constant velocity in a uniform channel. (orig.).

43083 Final focusing and enhanced disruption from an underdense plasma lens in a linear collider. Chen, P. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309 (US)); Rajagopalan, S.; Rosenzweig, J. *Physical Review [Section] D: Particles and Fields (USA),* 40(3): 923-926 (1 Aug 1989). DOE Contract AC03-76SF00515;W-31-109-ENG-38.

In this work we examine the viability of employing an underdense plasma lens as a final focusing method for a linear e^+e^- collider. The underdense plasma lens is superior to the overdense lens in that it improves focusing linearity and background event rate, but works well only for electrons. We thus consider the interaction of an e^- beam which is smaller than the e^+ beam at collision, a case we term "bootstrap disruption." The potential luminosity enhancement is determined by analysis of the lens optics and simulation of the bootstrap disruption.

43084 A compendium of computer codes used in particle accelerator design and analysis. Los Alamos Accelerator Code Group. *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1137-1326 (5 Apr 1989). (CONF-8707208--: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

We present a compilation of computer codes used in the design and analysis of particle accelerators. This document describes each code on a one- or two-page data sheet. All codes included in this compilation are filed at Los Alamos. (AIP)

43085 Fundamentals of intense relativistic electron beams. Miller, R. B. (TITAN Technologies, Albuquerque, New Mexico (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1729-1758 (5 Apr 1989). (CONF-8707208--: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

An intense charged particle beam can be characterized as an organized charged particle flow for which the effects of beam self-fields are of major importance in describing the evolution of the flow. Research employing such beams is an important field with applications ranging from the development of high power sources of coherent radiation to inertial confinement fusion. In this series of intense beam transport in a variety of situations of practical importance. We first present a brief summary of the development of the pulse power technology which is often used to generate these beams, followed by an elementary description of intense beam behavior based on single-particle beam envelope equations. We then describe in some detail the behavior of intense beams in high-voltage diodes, and the important processes involved in beam transport in vacuum, in plasma, and in neutral gas. Much of this material is taken from by book, "An Introduction to the Physics of Intense Charged Particle Beams" (Plenum, 1982), which may be consulted for more information and references.

43086 Application of pulse power technology to ultra high energy electron accelerators. Nation, J. A. (Laboratory of Plasma Studies and School of Electrical Engineering, Cornell University, Ithaca NY 14853, U.S.A. (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1759-1775 (5 Apr 1989). (CONF-8707208--: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

In this lecture we have presented a brief overview of the potential uses of pulse power technology for the development of new high energy electron accelerators. The recent developments in production of ultrahigh power coherent rf sources is encouraging and could well find immediate application in new high gradient accelerators. Pulse power technology, especially magnetic switching, provides a very good match to the driver requirements, although longer duration pulse power source would be useful.

43087 Coherence and statistical properties of photon beams with application to the free-electron laser. Bhattacharjee, A. (Department of Applied Physics, Columbia University, New York, New York 10027 (US)); Gjaja, I. *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1776-1797 (5 Apr 1989). (CONF-8707208--: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

In this paper, we review the theory of coherence and statistics of photon beams in general, with application to the FEL in particular. As far as the general theory is concerned, this paper may be regarded as a poor man's version of existing wisdom in quantum optics. The attempts here has been to distill the existing principles in a compact, self-contained way that will enable one to use them for a light source such as the FEL, which is the application of interest in this paper. If the paper succeeds in generating some interest on quantum optics FEL's and in FEL enthusiasts for quantum optics, it will have served its purpose.

43088 A comparison of the dielectric and plasma wakefield accelerators. Keinigs, R. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545 (US)); Peter, W.; Jones, M. E. *Physics of Fluids B: Plasma Physics (USA),* 1(9): 1872-1879 (Sep 1989).

A comparison of two advanced accelerator concepts, the plasma wakefield accelerator (PWA) and the dielectric wakefield accelerator (DWA), is presented. Emphasis focuses on the peak accelerating gradients and transformer ratios that can be achieved in these two devices. The effect of finite plasma size on the PWA is also analyzed. For the same cavity geometry and drive beam current, it is found that the dielectric wakefield accelerator can generate a peak field that is comparable to the field that can be generated in the plasma wakefield accelerator. Provided that ideal beam pulse shaping can be achieved, the transformer ratio for the PWA is ten times larger than that for the DWA. A change in this ideal pulse shape results in closer agreement for the transformer ratios. Given these encouraging preliminary results for the DWA it is concluded that the simplicity of employing a passive structure as an accelerating

medium warrants further experimental testing of the dielectric wake-field accelerator.

43089 Primer on beam dynamics in synchrotrons. Teng, L. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, IL 60510 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1878-1909 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

An introductory lesson on the beam dynamics in a synchrotron is presented. We first consider intensity-independent dynamics (single particle dynamics) and then intensity-dependent dynamics are discussed. (AIP)

43090 Longitudinal instabilities and stability criteria. Ng, K. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, IL 60510 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1969-2008 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

This paper is a short course on longitudinal instabilities and stability requirements for particle beams of circular accelerators which was presented at the 1987 U.S. Particle Accelerator School at Fermilab. The discussion includes criteria for longitudinal instability, stability limits, a longitudinal impedance estimation, a wire measurement (simulation) experiment, and results of an experiment to measure impedance by debunching. (AIP)

43091 Emittances through the Fermilab accelerator chain. Finley, D. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, IL 60510 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1910-1927 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

In this discussion we describe the development of the proton beam emittance through the Fermilab accelerator chain from the 750-keV pre-accelerator to the Tevatron. The measurements given here were taken during late 1984 and early 1986. They indicate there were some sources of emittance increase. Since that time, some improvements have been made and others are planned." (AIP)

43092 Beam loss. VanGinneken, A. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, IL 60510 (US)); Edwards, D.; Harrison, M. *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 2033-2072 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

This paper presents results from simulations of beam losses during the operation of a superconducting accelerator. The calculations use a combination of hadron/electromagnetic cascade plus elastic scattering codes with accelerator tracking routines. These calculations have been used in conjunction with the design of the Fermilab Tevatron.

43093 Technology and particle beams. Hartill, D. L. (Cornell University (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 2127-2137 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

This paper presents a brief survey of current uses for particle beams. Medicinal uses, synchrotron radiation sources, and materials modification by particle beams are discussed. (AIP)

4303 Auxiliaries and Components

Refer also to citation(s) 42499, 42627, 42710, 42949, 42950, 43079, 43087, 43895

43094 (AECL–9431) **Gyrotrons. Present status and future prospects.** Ebrahim, N.A. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. May 1987. 36p. Order Number DE89635435/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The purpose of this study is to bring together some relevant ideas and developments in the field of gyrotrons. The development of the electron cyclotron resonance maser (ECRM or Gyrotron) was an important break through in microwave electronics in the 1970s. As we look to the 1980's, we find scientists channelling their collective efforts to shorten the wavelength and increase output power and efficiency, thereby yielding an important device for generating high power microwave radiation. 24 refs.

43095 (AECL–9519) **Computer simulations of cryogenic linear accelerator structures.** Tran Ngoc, T.; Labrie, J.-P. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Sep 1987. 33p. Order Number DE89635436/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Cryogenic linear accelerator structures have high rf efficiency due to reduced resistivity and high heat transfer capability from the boiling heat transfer regime. Finite-element transient heat transfer and thermal stress analysis is used to simulate the behaviour of linear accelerator structures during quenching and predict their characteristics during power operation. 21 refs.

43096 (ANL/APS-TM–3, pp. 23-24) **Modular system.** Argonne National Lab., IL (USA). Apr 1988. (CONF-880194–: Workshop on synchrotron X-ray sources and new opportunities in the earth sciences, 18-20 Jan 1988). In *Synchrotron x-ray sources and new opportunities in the earth sciences: Workshop report.* Order Number DE88009858/JAW. Available from NTIS, PC A07/MF A01.

Members of the Earth and Planetary Sciences community plan to use the APS facility for a variety of applications. Each type of beam line described in the previous chapter offers a set of properties that are valuable for several applications. Therefore, each beam line will need to serve several different experiments. In addition many of the experiments will need more than one type of radiation. As a result, flexibility will be extremely important to the success of the program. In order to provide the required flexibility, we propose a system consisting of modules. Each module will be a rack on which there will be mounted all of the necessary instrumentation for a particular type of experiment. It will be designed so that it can be moved by crane from one beam line hutch to another or from staging area to beam line hutch and back. Each beam line, in turn, will be equipped to receive any of the various modules. There will be a simple arrangement for indexing each module on each beam line so that a minimum of alignment will be necessary when a module is installed. An example of a module would be an energy dispersive x-ray diffraction system consisting of adjustable fine slits, a sample mounting system with computer-driven translational and orientational alignment capabilities, telescopes for alignment, solid state detector, multichannel analyzer, computer, and the associated power supplies and electronics. Such a module would be suitable for high pressure-temperature diamond cell studies.

43097 (BNL–42947) **Magnetic measurements of permanent magnet insertion devices at the BNL-NSLS [Brookhaven National Laboratory–National Synchrotron Light Source].** Solomon, L.; Decker, G.; Galayda, J.; Kitamura, M. Brookhaven National Lab., Upton, NY (USA). 1989. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890335–241-Vugraphs: 13. particle accelerator conference, 20-23 Mar 1989). Order Number DE89016408/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Since June 1988, three permanent magnet insertion devices of the hybrid type have been installed into the x-ray ring at the National Synchrotron Light Source at Brookhaven National Lab. as part of the Phase II facility upgrade. The three magnets consist of a soft x-ray undulator (SXU) and two hybrid wigglers, with peak fields of 0.35 and 1.2 Tesla respectively. The SXU magnet has iron poles, samarium cobalt permanent magnets, 80mm period length, 77 poles, and a gap range of 31–100 mm. For this gap range the undulator parameter K, where $K = 0.934\ B(\text{Tesla})\lambda(\text{cm})$, ranges from 2.6 to 0.15. The hybrid wigglers have vanadium pomander poles, samarium cobalt magnets, 120MM periods, 31 poles, and a gap range of 22–122mm. For this gap range K ranges from 13.0 to 0.5. All three of these magnets have electromagnetic coils which can be powered to adjust the value of the magnet field integral. Both point and integral magnetic measurements were performed on these magnets; some of the measurement results will be presented in this paper.

43098 (CONF-881049–74) **Performance of the high power rf system for the NIST–Los Alamos racetrack microtron.** Cutler,

R.I.; Young, L. National Inst. of Standards and Technology, Gaithersburg, MD (USA); Los Alamos National Lab., NM (USA). 1988. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AI01-87ER40332;W-7405-ENG-36. From 14. linear accelerator conference (LINAC-14); 3-7 Oct 1988. Order Number DE89016082/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The high power RF system of the NIST-LANL RTM has been tested at nominal full power levels and has accelerated electron beams successfully. RF stability and calibration measurements have been made using the accelerated electron beam. These measurements have been used to calculate the effective shunt impedance of the side- coupled accelerator structure. RF stability measurements were also performed using power meters and phase detectors. 7 refs., 4 figs.

43099 (CONF-890703–14) **Emittance characteristics of negative ion beams generated by the sputter technique.** Alton, G.D. Oak Ridge National Lab., TN (USA). 1989. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From International conference on ion sources; Berkeley, CA (USA); 9-15 Jul 1989. Order Number DE89015866/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Average emittance data for ion beams extracted from cesium-sputter negative ion sources equipped with spherical, ellipsoidal, and cylindrical geometry cesium-surface ionizers are presented. The attributes of the respective source geometries are described in terms of their cesium ion optical properties. The results of recent measurement of the emittances of momentum-analyzed beams extracted from the ellipsoidal geometry source are also presented. These measurements indicate the presence of a species-dependent effect. The effect is believed to be attributable to differences in the energy spreads of the respective negative ion beams introduced by the sputter generation process. 11 refs., 8 figs.

43100 (IFVE-ONF–88-26) **Minimal software package for operations with the CAMAC/SUMMA modules using the AKK-196 microcomputer.** Kozelov, A.V.; Lebedev, A.A.; Medved', S.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1988. 4p. (In Russian). Order Number DE89635437/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Software interface for operation with CAMAC/SUMMA modules, used in the system of automation of beam monitoring in labelled neutrino complex is discribed. Independent crate controller ACC-196 with builtin microcomputer on the microprocessor set base of 1801 series is used in the system. The package is composed of 8 subprograms. 8 refs.

43101 (IFVE-OUNK–88-132) **On-line system to measure magnetic characteristics of steel samples.** Antonichev, G.M.; Afanas'ev, O.V.; Dubasov, Yu.B. and others. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1988. 8p. (In Russian). Order Number DE89633443/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the journal Prib. Tekh. Ehksp.

Using on-line system, one investigates the effect of low-temperaturre (up to 4.2 K) cooling on magnetic properties of electrotechnical steel samples. Dependence of hysteresis losses in proper cycles of reverse magnetization with values of magnetic induction in a sample, which reach saturation induction, is studied. Application of the system allows to carry out routine monitoring of magnetic characteristics of different steels and to choose the most fitting one for application as a superconducting-dipole yoke of the IHEP accelerating storage complex. The system includes the 100 W programmable bipolar current source, analogue integrator, programmable timer and reference voltage generator, two-channel programmable amplifier, two bipolar 12-th bit ADC with 4K memory buffer, SUMMA interface and microcomputer CM-4. 6 refs.; 3 figs.; submitted to the journal Prib. Tekh. Ehksp.

43102 (INP–1302/PS, pp. 281-285) **Production of secondary radioactive beams at GANIL from 44 MeV/u Ar projectiles.** Bimbot, R. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire); Della Negra, S.; Auger, P.; Bastin, G.; Anne, R.; Delagrange, H.; Hubert, F. Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

The GANIL ^{40}Ar beam at 44 MeV/u, with a 99 mg/cm^2 Be primary target was used to produce radioactive beams. The spatial distribution and performance of the radioactive beam was studied. 3 refs., 1 fig., 1 tab. (L.I.).

43103 (INS–743) **Acceleration performance of a 50-MHz split coaxial RFQ and the design of a 25.5-MHz prototype.** Tokuda, N.; Arai, S.; Fukushima, T.; Morimoto, T.; Tojyo, E. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Mar 1989. 4p. Order Number DE89906509/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Acceleration tests on a 50-MHz split coaxial RFQ have been conducted at INS. The 2-m long RFQ has accelerated protons from 2 to 60 keV. The experimental results concerning beam emittance and transmission efficiency agree with predictions of a computer simulation. Following this success, we are fabricating a 25.5-MHz prototype of 2-m long. The issues of the study are to establish a structure standing a high-power operation and to accelerate heavy ions with a charge-to-mass ratio larger than 1/30. (author).

43104 (JINR–9-88-384) **Beam diagnostics station for slow extraction channel of JINR synchrophasotron.** Buldakovskij, V.N.; Grigor'ev, V.P.; Zinov'ev, L.P. and others. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 8p. (In Russian). Order Number DE89635434/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The beam monitoring station for a slow extraction channel of the JINR synchrophasotron designed and manufactured at JINR is presented. It consists of an universal cylindrical vacuum chamber where a section for diagnostics of extracted beam is located. For purposes of beam diagnostics the following detectors were used: scintillation counters, multiwire ionization chambers, TV screens cylindrical ionization chambers for measuring beam absolute intensity etc. The driver used for beam diagnostics detector motion in vacuum volume of the chamber is described. The ionization chamber design and their parameters applied as detectors for control and monitoring of slow extraction beam parameters of JINR synchrophasotron are presented parameters of JINR synchrophasotron are presented. 3 refs.; 6 figs.; 1 tab.

43105 (KEK–88-9, pp. 78-104) **Inelastic instruments at the ISIS facility.** Taylor, A.D. (Rutherford Appleton Lab., Chilton (UK)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8710488–: Workshop on neutron scattering research with intense spallation neutron source, 6-7 Oct 1987). In *Proceedings of the workshop on neutron scattering research with intense spallation neutron source 'today and tomorrow'. First meeting of Japan-UK collaboration in neutron scattering research.* Order Number DE89906380/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

This summarises the status of the inelastic spectrometers at the ISIS facility and gives some highlights from their scientific programme. The inelastic spectrometers HET, TFXA and IRIS are now being used routinely by UK and International research groups and have produced notable scientific results. Work has progressed steadily on eVS. The PRISMA spectrometer, the product of a collaboration between CNR, Italy and RAL, was installed this summer. Earlier this year an agreement was reached in principle between the Rutherford Appleton Laboratory and the University of Wurzburg (West Germany) to build a second spectrometer (ROTAX) for the study of coherent inelastic excitations. A more sophisticated technical concept than that of PRISMA, based on a nonuniformly rotating analyser, it will allow a greater flexibility in the choice of dynamic scans. Substantial progress has also been made on the design of MARI, the sister spectrometer to HET, which is being built as part of the UK-Japan collaboration on pulsed neutron scattering. (author).

43106 (KEK–88-9, pp. 17-39) **ISIS status, September 1987.** Williams, W.G. (Rutherford Appleton Lab., Chilton (UK)). National

Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8710488–: Workshop on neutron scattering research with intense spallation neutron source, 6-7 Oct 1987). In *Proceedings of the workshop on neutron scattering research with intense spallation neutron source 'today and tomorrow'. First meeting of Japan-UK collaboration in neutron scattering research.* Order Number DE89906380/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Now, ISIS is the most powerful operational pulsed neutron source in the world. The layout of the facility and its nominal design performance are shown. The injector is a 70 MeV linear accelerator for H^- ions, the electrons of which are stripped at the injection into the proton synchrotron. Intense 0.4 μs pulses of protons are accelerated in the synchrotron up to nearly 800 MeV, thereafter, they are extracted through a beam channel to the target station. The target is the plates of depleted uranium clad with Zircaloy, and each proton produces 25 neutrons with MeV level energy. These neutrons are slowed down in two ambient water moderators placed above the target and two cryogenic moderators placed below the target, one is liquid methane at 95 K and another is supercritical hydrogen at 25 K. The target and moderator assembly is surrounded by a beryllium reflector cooled with D_2O. The whole target complex is surrounded by a biological shield, in which there are 18 neutron beam holes which currently serve 12 spectrometers. The recent performance of ISIS and a number of the troubles occurred are reported. 11 experimental facilities or instruments for condensed matter research are provided. Three neutron spectrometers, PRISMA, SANDALS and MARI are described. (K.I.).

43107 (KEK–88-9, pp. 40-77) **Diffraction instruments at the ISIS facility.** Johnson, M.W. (Rutherford Appleton Lab., Chilton (UK)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8710488–: Workshop on neutron scattering research with intense spallation neutron source, 6-7 Oct 1987). In *Proceedings of the workshop on neutron scattering research with intense spallation neutron source 'today and tomorrow'. First meeting of Japan-UK collaboration in neutron scattering research.* Order Number DE89906380/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

The report describes the instruments used for elastic scattering experiments at the ISIS facility, and gives a few examples of the type of science performed on each instrument over the last year. The instruments include HRPD, LAD, SXD, POLARIS, CRISP and LOQ. HRPD (high resolution powder diffractometer) is a vary high resolution neutron powder diffractometer situated at the end of a ~ 100 m guide. The $\Delta d/d$ resolution of $\sim 5 \times 10^{-4}$ permits not only traditional neutron powder diffraction experiments based around the Rietvelt profile refinement method but also new experiments such as abinitio structure determination and line broadening analysis. LAD (liquids and amorphous materials diffractometer) is used for such science areas as molten salts, molecular liquids and amorphous system. Work with SXD (single crystal diffractometer) on a well characterized single crystal sample of SrF_2 has produced some interesting and unique data on the anharmonic thermal vibrations of the fluorine atoms. POLARIS is the polarised neutron spectrometer in development at ISIS. Neutron polarisation analysis is the only method by which an unambiguous separation of magnetic, nuclear coherent and nuclear spin incoherent scattering can be achieved. The critical reflection spectrometer, CRISP, is designed to study problems in surface and interfacial chemistry, surface magnetism and low-dimensional structures. (N.K.).

43108 (KEK–88-9, pp. 190-196) **Polarized proton filter at KENS.** Masuda, Y. (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8710488–: Workshop on neutron scattering research with intense spallation neutron source, 6-7 Oct 1987). In *Proceedings of the workshop on neutron scattering research with intense spallation neutron source 'today and tomorrow'. First meeting of Japan-UK collaboration in neutron scattering research.* Order Number DE89906380/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Polarized proton filter as a neutron polarize was constructed for the spallation neutron source. Protons in the filter material were polarized up to 80 % by the microwave pumping in a ^4He bath. Epithermal neutrons were polarized upon passing through the polarized proton filter. The neutron polarizations were more than 70 %. The neutron transmittance of the filter was about 0.25. This performance is statisfactory in caring out polarized neutron experiment with the spallation neutron source. In fact, parity-nonconserving effect in neutron radiative capture reaction was examined using this apparatus and a very large asymmetry was found in a p-wave resonance. (author).

43109 (KEK–88-9, pp. 162-176) **Computing and data acquisition at the ISIS facility.** Johnson, M.W. (Rutherford Appleton Lab., Chilton (UK)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8710488–: Workshop on neutron scattering research with intense spallation neutron source, 6-7 Oct 1987). In *Proceedings of the workshop on neutron scattering research with intense spallation neutron source 'today and tomorrow'. First meeting of Japan-UK collaboration in neutron scattering research.* Order Number DE89906380/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

The report gives an overview of the hardware and software employed at the ISIS facility for data acquisition, analysis and display. The report also explains the philosophy behind the systems chosen, and lastly, looks to the future to see what problems have to be faced in moving towards neutron instruments employing large numbers of detectors and increased neutron fluxes. The interconnected systems of Data Acquisition Electronics (DAE), CAMAC control, Front-End Minicomputers (FEMS), HUB computer and associated software which provides the ISIS instrumentation with its control, acquisition, display, analysis and archival functions is collectively known as the PUNCH system. The DAE consists of a System Crate and up to 16 Instrument Crates for each instrument. They are joined by the Instrument Bus (IB). The system crate is located close to the FEM computer and is connected to it by an extension of the VAX UNIBUS (or QBUS). The Instrument crates are located close to the instrument detectors and hence the Instrument Bus is typically 10-30 m long. At ISIS, it was realised that there was sufficient commonality in the primary analysis and display requirements to justify a common approach. The result has been the production of a language, called GENIE, for neutron data manipulation and display. (Nogami, K.).

43110 (KEK–88-9, pp. 177-183) **KENS data acquisition system KENSnet.** Arai, Masatoshi (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)); Furusaka, Michihiro; Satoh, Setsuo; Johnson, M.W. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8710488–: Workshop on neutron scattering research with intense spallation neutron source, 6-7 Oct 1987). In *Proceedings of the workshop on neutron scattering research with intense spallation neutron source 'today and tomorrow'. First meeting of Japan-UK collaboration in neutron scattering research.* Order Number DE89906380/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

The installation of a new data acquisition system KENSnet has been completed at the KENS neutron facility. For data collection, 160 Mbytes are necessary for temporary disk storage, and 1 MIPS of CPU is required. For the computing system, models were chosen from the VAX family of computers running their proprietary operating system VMS. The VMS operating system has a very user friendly interface, and is well suited to instrument control applications. New data acquisition electronics were developed. A gate module receives a signal of proton extraction time from the accelerator, and checks the veto signals from the sample environment equipment (vacuum, temperature, chopper phasing, etc.). Then the signal is issued to a delay-time module. A time-control module starts timing from the delayed start signal from the delay-time module, and distributes an encoded time-boundary address to memory modules at the preset times anabling the memory modules to accumulate data histograms. The data acquisition control program (ICP) and the general data analysis program (Genie) were both developed at ISIS, and have been installed in the new data acquisition system. They give the experimenter 'user-friendly' data acquisition and a good environment for data manipulation. The ICP controls the DAE and transfers the histogram data into the computers. (N.K.).

43111 (KEK–88-9, pp. 184-189) **Broad-band neutron polarisation at ISIS.** Williams, W.G. (Rutherford Appleton Lab., Chilton

(UK)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8710488--: Workshop on neutron scattering research with intense spallation neutron source, 6-7 Oct 1987). In *Proceedings of the workshop on neutron scattering research with intense spallation neutron source 'today and tomorrow'. First meeting of Japan-UK collaboration in neutron scattering research.* Order Number DE89906380/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

The paper describes some of the recent polarised beam developments at ISIS. The polarised beam version of the critical reflection spectometer CRISP was commissioned early in 1987. Incident beam polarisation is provided using a cobalt-titanium polarising supermirror which is effective over a θ/λ range up to 2.0 deg nm^{-1}, and contains a gadolinium-titanium anti-reflecting underlayer. A new method is devised for calibrating the beam polarisation $P(\lambda)$ and spin flipper efficiency $f(\lambda)$ on CRISP which is applicable to all types of slow polarised neutron instruments. The basic principle of the method is to use an analyser which is identical to the polariser, and to measure three quantities: flipping ratio with the spin flipper 'off' and 'on'; the shim ratio, i.e. intensity ratio 'with' and 'without' a depolarising mild steel shim with efficiency S placed between the polarisers, first with the spin flipper 'off'; and the shim ratio with the spin flipper 'on'. The principle of using the spin-dependent absorption by polarised nuclei in a filter to polarise thermal and cold neutron beams is now well established. Highly effective Gd:Ti antireflecting layers have been developed which absorb the unwanted spin neutrons at all (θ/λ). This means that the polarisation of the reflected neutrons can now be incorporated into polarising neutron guides and polarising Soller benders. (N.K.).

43112 (KEK–88-11) **Improvements on monitor system in the KEK 2.5-GeV linac.** Shidara, T.; Oogoe, T.; Ogawa, Y. and others. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jan 1989. 25p. Order Number DE89906469/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Improvements to the monitor system of the KEK 2.5-GeV linac have been undertaken. Energy analyzing stations were added to both the positron generator linac and the 2.5-GeV electron linac in order to realize easier checking of beam energy. Wall current monitors and profile monitors were added in the beam transport line between the positron generator linac and the 2.5-GeV electron linac in order to realize easier positron-beam transfer. As a result of the installation of an automatic beam-current-surveillance system and with other existing surveillance systems, more reliable and easier operation of the linac is expected. (author).

43113 (KFK–4554) **Generation and focusing of an intense pulsed proton beam using a self-magnetically B_Θ-insulated ion diode.** Schimassek, W. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik. Mar 1989. 78p. (In German). Order Number DE89796017/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

A selfmagnetically B_Θ-insulated ion diode was investigated and optimized for generation and focusing of a pulsed high intensity proton beam for generation of high power-density in matter. The experiments were done at the pulsed power line KALIF (2 MV, 50 ns, 2 Ω). The protons got energies up to 1.8 MeV and the proton ratio in the ion beam was about 50%. The efficiency of the ion current depends on the magnetic field in the diode and have reached values up to 70%. The maximum total diode current was about 800 kA. The focusing properties were improved by optimizing the diode and gap geometries and decreasing the beam divergence. The focus diameter was reduced to about 10 mm giving a focused proton power density of about 0.35 TW/cm^2. Measurements of the current density of the protons at the anode were done for the first time and a good agreement with Particle-in-Cell-calculations was found. The electron-loss in the diode was reduced leading to a higher life-time of the diode of 10-15 pulses. (orig.).

43114 (LBL–25964) **AC magnetic measurements of the ALS Booster Dipole Engineering Model Magnet.** Green, M.I.; Keller, R.; Nelson, D.H.; Hoyer, E. Lawrence Berkeley Lab., CA (USA). Mar 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–248: 13. particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989). Order Number DE89016345/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

10 Hz sine wave and 2 Hz sawtooth AC magnetic measurements of he curved ALS Booster Dipole Engineering Model Magnet have been accomplished. Long curved coils were utilized to measure the integral transfer function and uniformity. Point coils and a Hall Probe were used to measure magnetic induction and its uniformity. The data were logged and processed by a Tektronix 11401 digital oscilloscope. The dependence of the effective length on the field was determined from the ratio of the integral coil signals to the point coil signals. Quadrupole and sextupole harmonics were derived from the point and integral uniformity measurements. 5 refs., 4 figs., 2 tabs.

43115 (LBL–25965) **Design, fabrication, and calibration of curved integral coils for measuring transfer function, uniformity, and effective length of LBL ALS [Lawrence Berkeley Laboratory Advanced Light Source] Booster Dipole Magnets.** Green, M.I.; Nelson, D.; Marks, S.; Gee, B.; Wong, W.; Meneghetti, J. Lawrence Berkeley Lab., CA (USA). Mar 1989. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–246: 13. particle accelerator conference, 20-23 Mar 1989). Order Number DE89016347/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

A matched pair of curved integral coils has been designed, fabricated and calibrated at Lawrence Berkeley Laboratory for measuring Advanced Light Source (ALS) Booster Dipole Magnets. Distinctive fabrication and calibration techniques are described. The use of multifilar magnet wire in fabrication integral search coils is described. Procedures used and results of AC and DC measurements of transfer function, effective length and uniformity of the prototype booster dipole magnet are presented in companion papers. 8 refs.

43116 (LBL–25973) **Advanced Light Source (ALS) beam position monitor.** Hinkson, J.; Johnston, J.; Ko, I. Lawrence Berkeley Lab., CA (USA). Mar 1989. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–249: 13. particle accelerator conference, 20-23 Mar 1989). Order Number DE89016312/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The ALS is a third-generation synchrotron light source currently under construction at LBL. The accelerator complex will consist of a 1–2 GeV electron storage ring, a 1.5 GeV booster synchrotron, a 50 MeV linac, and low and high energy beam transfer lines. Beam pickup devices and electronic instrumentation has been specified for the accelerator, and development of the beam position monitor (BPM) systems is well under way. Considerable effort has gone into the storage ring BPM system design in particular because of the need for very fast and accurate measurements. We meet the speed and accuracy requirements in the electronics with parallel processing and error correction techniques. A tuned receiver is provided for every beam position pickup, and for every array of four pickups there is a microprocessor controlling the measurement and recording data. In this paper we report on the requirements, design, and performance of the storage ring BPM system. 3 refs., 3 figs.

43117 (LBL–25992) **Insertion devices for the Advanced Light Source at LBL.** Hassenzahl, W.; Chin, J.; Halbach, K.; Hoyer, E.; Humphries, D.; Kincaid, B.; Savoy, R. Lawrence Berkeley Lab., CA (USA). Mar 1989. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–247: 13. particle accelerator conference, 20-23 Mar 1989). Order Number DE89016348/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Advanced Light Source (ALS) at the Lawrence Berkeley Laboratory will be the first of the new generation of dedicated synchrotron light sources to be put into operation. Specially designed insertion devices will be required to realize the high brightness photon beams made possible by the low emittance of the electron beam. The complement of insertion devices on the ALS will include undulators with periods as short as 3.9 cm and one or more high field wigglers. The first device to be designed is a 5 m long, 5 cm period, hybrid undulator. The goal of very high brightness and high harmonic output imposes unusually tight tolerances on the magnetic field quality and thus on the mechanical structure. The design process, using a generic structure for all undulators, is described. 5 refs., 4 figs., 1 tab.

43118 (LBL–26012) **Magnet power supplies for the Advanced Light Source.** Jackson, L.T.; Lutz, I.C. Lawrence Berkeley Lab., CA (USA). Mar 1989. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–245: 13. particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989). Order Number DE89016346/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Lawrence Berkeley Laboratory (LBL) is building an Advanced Light Source (ALS) to produce synchrotron radiation. An electron linear accelerator, and a booster synchrotron are used to accelerate the electron beam to 1.5 GeV to fill the storage ring. This paper describes the power supplies used for the magnets in the booster and the storage ring and the interface requirements for computer control and monitoring the power supplies and magnet currents. 1 ref., 3 figs., 2 tabs.

43119 (UCRL–100316) **50 MHz 12 MW induction linac current modulator.** Bowles, E.E.; Turner, W.C. Lawrence Livermore National Lab., CA (USA). 17 May 1989. 6p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. (CONF-890665–43: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, CA (USA), 12-14 Jun 1989). Order Number DE89016641/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper describes a scheme to control the intrapulse energy variations of long pulse bursts of an induction linac. Analog control over the electron beam injector current is exercised in such a way that accelerator beam load variations compensate for thermal impedance variations of the accelerator cell ferrites. Circuit topology and test data are presented. The circuit uses 64 planar triodes to modulate the shunt impedance of two induction cells of the electron beam injector. Delayed feedback is used to apply a control signal to the modulator that varies the injector current to null the interpulse beam energy sweep at the linac output. The modulator exerts analog control over the top 5% of the beam current. It operates at a 60-ns pulse width and at up to a 0.1% duty factor. 8 figs.

43120 (UCRL–100416) **A conceptual design for an actively cooled, high-average-power electron-beam accelerator.** VanSant, J.; Stone, R.R.; Hedtke, R.; Kang, S.W.; Ng, D. Lawrence Livermore National Lab., CA (USA). 25 May 1989. 9p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. (CONF-890815–20: 24. intersociety energy conversion engineering conference, Washington, DC (USA), 7-12 Aug 1989). Order Number DE89016648/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A major goal of researchers in the Beam Research Program at the Lawrence Livermore National Laboratory is to use induction linear accelerators to produce high-average-power electron beams. As the peak power and the duty factor of the electron beam are increased, the method by which residual electron energy is absorbed becomes increasingly important. We have completed a conceptual design of an electron beam absorber system that uses water as both an energy absorber and a cooling medium. This configuration uses an aluminum window to separate the water absorber from a vacuum beamline. Such an arrangement has several desirable features. First, any necessary reconfiguration for an increase or decrease in run time and/or beam power is minimal. Also, the subsystems use current technology. We describe a point design for the window, the absorber tank, and its subsystems. 10 refs., 10 figs., 1 tab.

43121 Mirror and grating surface figure requirements for grazing incidence synchrotron radiation beamlines. Hulbert, S.L. (National Synchrotron Light Source, Brookhaven National Lab., Upton, NY (US)); Sharma, S. vp. of Grazing incidence optics for astronomical and laboratory applications. Bowyer, S.; Green, J.C. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8708242–: Conference on XUV optics and applications - grazing incidence optics for astronomical and laboratory applications, 16-21 Aug 1987).

At present, grazing incidence mirrors are used almost exclusively as the first optical element in VUV and soft x-ray synchrotron radiation beam lines. The performance of these mirrors is determined by thermal and mechanical stress-induced figure errors as well as by figure errors remaining from the grinding and polishing process. With the advent of VUV and soft x-ray undulators and wigglers has come a new set of thermal stress problems related to both the magnitude and the spatial distribution of power from these devices. In many cases the power load on the entrance slits and gratings in these beamlines is no longer negligible. The dependence of thermally-induced front-end mirror figure errors on various storage ring and insertion device parameters (especially those at the NSLS) and the effects of these figure errors on two classes of soft x-ray beam lines are presented.

43122 Progress on a 2 MV injector for a scaled HIF accelerator experiment. Rutkowski, H.L. (Lawrence Berkeley Lab., CA (USA)); Faltens, A.; Humphries, S.; Vanecek, D.; Pike, C.; Johnson, R.M.; Meyer, E.A. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 278(1): 206-212 (15 May 1989). DOE Contract AC03-76SF00098. (CONF-8806101–: International symposium on heavy ion inertial fusion, Darmstadt (Germany, F.R.), 28-30 Jun 1988).

A sixteen-beam injector to supply 500 mA per beam of C^+ ions, which was initially designed and partially constructed at Los Alamos National Laboratory, is under further development at LBL. We report on development work involving single and multiple carbon arc sources. These sources are useful because they can easily supply the 25 mA/cm^2 needed for the device. They are pulsed sources which do not cause unacceptable background gas loads in the column. We present emittance and reproducibility data. Acceleration is by a high gradient column using a succession of aperture lenses to focus the beam. The electrodes are arranged with holes for parallel beam inside 28 inch alumina insulators. Data on beam propagation and electron trapping in the column are presented. The acceleration potential is provided by a Marx bank with inductive grading along the structure. The resulting 34 μs rise time pulse allows the accelerating potential to equilibrate along the column before the current is injected. Acceleration occurs during as 1 μs window at a peak of pulse, in which the voltage is flat within 0.1%. (orig.).

43123 Simulations of high-brightness rf photocathode guns for LLNL-SLAC-LBL 1 GeV test experiment. Chen Yujiuan (Lawrence Livermore National Lab., CA (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 279(3): 433-442 (15 Jul 1989). DOE Contract W-7405-ENG-48.

An ideal rf photocathode gun in a π-mode configuration supporting only a single mode with no nonlinear rf field is studied numerically by using the simulation code PARMELA. For a given electron bunch, the normalized emittance can be minimized. Both the minimum normalized emittance and the optimized accelerating field are proportional to the square root of the peak current. Three possible rf photocathode guns for LLNL-SLAC-LBL 1 GeV test are simulated. It is found that both a 2 ps half-width bunch and a 6 ps half-width bunch with the transverse emittance roughly 8-17 mm mrad and 1 nC charge per bunch can be generated by guns with (1) f = 1269 MHz, E_0 = 30 MV/m; (2) f = 1269 MHz, E_0 = 60 MV/m; and (3) f = 2856 MHz, E_0 = 60 MV/m. Here, f is the rf frequency, and E_0 is the peak accelerating field. (orig.).

43124 A dynamic method for continuously measuring magnetic field profiles in planar micropole undulators with submillimeter gaps. Tatchyn, R. (Stanford Univ., CA (USA). Stanford Synchrotron Radiation Lab.). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 279(3): 655-664 (15 Jul 1989). DOE Contract AC03-82ER13000;FG06-85ER13309.

Conventional techniques for measuring magnetic field profiles in ordinary undulators rely predominantly on Hall probes for making point-by-point static measurements. As undulators with submillimeter periods and gaps become available, such techniques will start becoming untenable, due to the relative largeness of conventional Hall probe heads and the rapidly increasing number of periods in devices of fixed length. In this paper a method is presented which can rapidly map out field profiles in undulators with periods and gaps extending down to the 100 μm range and beyond. The method, which samples the magnetic field continuously, has been used successfully in profiling a recently constructed 726 μm period

undulator, and seems to offer some potential advantages over conventional Hall probe techniques in measuring large-scale undulator fields as well. (orig.).

43125 Principles and technology of RFQs. Schempp, A. (Institut fur Angewandte Physik, Universitat Frankfurt D6000 Frankfurt/M, W. Germany (DE)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1477-1499 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

The RFQ is a linear accelerator structure for low velocity ions which focuses and accelerates with the help of electrical radio-frequency (rf) quadrupole fields. It was first proposed by Kapchinskij and has since been applied in numerous labs mainly as an injector for Alvarez accelerators. The RFQ can simultaneously focus, bunch, and accelerate a high current beam from the ion source, which can be on a relatively low d.c. potential. This allows the use of special ion sources which can be bulky and can have high power consumption like sources for polarized or highly charged ions.

43126 Intense, low emittance injectors for RF electron linacs. Smith, T. I. (High Energy Physics Laboratory, Stanford University, Stanford, California 94305 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1543-1552 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

A workshop on low emittance beams was held at Brookhaven National Laboratory from March 20 to March 25, 1987. The workshop was held under the auspices of the International Committee on Future Accelerators (ICFA), and was intended to explore issues relating to the production of electron beams with an unprecedented combination of high charge density and low emittance. The following material is largely a result of discussions held during the workshop, and represents an attempt to estimate the severity of some of the problems which would be encountered in the design of an RF linac injector consistent with the workshop goals.(AIP)

43127 Photocathode RF guns. Sheffield, R. L. (MS H825, Los Alamos National Laboratory, Los Alamos, NM 87545 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1500-1531 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

Free-electron oscillators and amplifiers require electron accelerators capable of delivering pulse trains of electron bunches of high charge density in a wiggler or undulator. A high electron density implies a high peak current (100 A to 2000 A) and a low transverse beam emittance (<80 π·mm·mrad, determined by matching the transverse size of the electron beam to the optical beam in the wiggler). Electron beam collider machines also require high peak currents (>8nC in picoseconds) with extremely small emittances (<10 π·mm·mrad).

43128 Low emittance thermionic electron guns. Herrmannsfeldt, W. B. (Stanford Linear Accelerator Center, Stanford, California 94309 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1532-1542 (5 Apr 1989). DOE Contract AC03-76SF00515. (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

A description of low emittance thermionic electron guns used for injection of electron beam into free electron lasers (FEL) and linear accelerators is given. A physical description of electron beam emitted from thermionic cathodes is sketched. Examples of electron guns used in FEL's and electron linacs are presented. (AIP)

43129 Final focus systems for linear colliders. Erickson, R. A. (Stanford Linear Accelerator Center, Stanford, California 94305 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1553-1591 (5 Apr 1989). DOE Contract AC03-76SF00515. (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

In this paper, the functions of final focus systems in general will be described, along with a discussion of performance limitations arising from some of these practical design considerations. To illustrate the main ideas, the final focus system of the Stanford Linear Collider will be presented, and the basis for the key parameter choices will be discussed. (AIP)

43130 Positrons for linear colliders. Ecklund, S. (Stanford Linear Accelerator Center, Stanford, California 94305 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1592-1614 (5 Apr 1989). DOE Contract AC03-76SF00515. (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

The pair production process of obtaining positrons has the advantage of being essentially instantaneous, allowing production of beams with a time structure or bunching required for the linear collider. Photons which are used for the pair production are produced via electromagnetic cascades from electron interactions in matter. We describe Monte Carlo simulations of this method of positron production. (AIP)

43131 Perspectives on micropole undulators in synchrotron radiation technology. Tatchyn, R. (Stanford Synchrotron Radiation Laboratory, Stanford University, Stanford, California 94305, and Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403 (US)); Csonka, P.; Toor, A. *Review of Scientific Instruments (USA),* 60(7): 1796-1804 (Jul 1989). DOE Contract AC03-82ER13000.

Micropole undulators promise to advance synchrotron radiation (SR) technology in two distinct ways. The first is in the development of economical, low-energy storage rings, or linacs, as soft x-ray sources, and the second is in the opening up of gamma-ray spectral ranges on high-energy storage rings. In this paper the promise and current status of micropole undulator (MPU) technology are discussed, and a review of some practical obstacles to the implementation of MPU's on present-day storage rings is given. Some successful results of recent performance measurements of micropole undulators on the Lawrence Livermore National Laboratory linac are briefly summarized.

43132 Magnetic measurements on insertion devices at NSLS. Decker, G. (National Synchrotron Light Source, Brookhaven National Observatory, Upton, New York 11973 (US)); Galayda, J.; Solomon, L.; Kitamura, M. *Review of Scientific Instruments (USA),* 60(7): 1845-1848 (Jul 1989).

Magnetic measurements on three insertion devices for use in the National Synchrotron Light Source (NSLS) x-ray ring are described. Hall probes were used for field mapping, and rotating long coils were used to determine integrated multipole coefficients. Results are presented for an iron pole-REC hybrid indulator, a vanadium permendur pole-REC hybrid wiggler, and a 5 T superconducting wiggler.

43133 Antiproton source. Peoples, J. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, IL 60510 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 1845-1877 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

Design of the antiproton source for the Fermilab Tevatron is presented Antiprotons are produced when 120 GeV protons are extracted from the main ring and directed onto a tungsten target in the $\bar{p}$ target station. The beam optics required to obtain a luminosity of 10^{30} cm^{-2} sec^{-1} with 6×10^{10} antiprotons per bunch or 2×10^{11} $\bar{p}$'s every 12 hours are described. (AIP)

43134 Multilayer mirrors as power filters in insertion device beamlines. Kortright, J. B. (Center for X-ray Optics, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720 (US)); DiGennaro, R. S. *Review of Scientific Instruments (USA),* 60(7): 1995-1998 (Jul 1989). DOE Contract AC03-76SF00098.

The power-filtering capabilities of multilayer bandpass x-ray mirrors relative to total reflection low-pass mirrors are presented. Results are based on calculations assuming proposed wiggler sources on the upcoming generation of low-energy (1.5 GeV) and high-energy (7.0 GeV) synchrotron radiation sources. Results show that multilayers outperform total reflection mirrors in terms of reduction in reflected power by roughly an order of magnitude, with

relatively small increases in total absorbed power and power density over total reflection mirrors, and with comparable reflected flux values. Various aspects of this potential application of multilayer x-ray optics are discussed.

43135 Variable focus crystal diffraction lens. Smither, R. K. (Argonne National Laboratory, Argonne, Illinois 60439 (US)). *Review of Scientific Instruments (USA),* 60(7): 2044-2047 (Jul 1989). DOE Contract W-31-109-ENG-38.

A new method has been developed to control the shape of the surface of a diffracting crystal that will allow it to function as a variable focus crystal diffraction lens for focusing photon beams from a synchrotron source. The new method uses thermal gradients in the crystal to control the shape of the surface of the crystal in two dimensions and allows one to generate both spherical and ellipsoidal surface shapes. In this work the thermal gradient was generated by core drilling two sets of cooling channels in a silicon crystal so that cooling or heating fluids could be circulated through the crystal at two different levels. The first set of channels is close to the surface of the crystal where the photon beam strikes it. The second set of channels is equidistant from the back surface. If a concave surface is desired, the fluid in the channels just below the surface exposed to the beam is cooler than the fluid circulating through the channels near the back surface. If a convex surface is desired, then the cooling fluid in the upper channels near the surface exposed to the incident photon beam is warmer than the fluid in the lower channels. The focal length of the crystal lens is varied by varying the thermal gradient in the crystal. This approach can also be applied to the first crystal in a high power synchrotron beamline to eliminate the bowing and other thermal distortions of the crystal caused by the high heat load.

43136 Resonant extraction at the tevatron. Harrison, M. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, IL 60510 (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 2009-2032 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

At the most basic level, extraction is the process of persuading a circulating beam to leave the machine in a controlled fashion. For a variety of reasons the method we choose to implement at the Tevatron was that of horizontal half-integer resonant extraction.

43137 Design of the laser-driven RF electron gun for the BNL accelerator test facility. McDonald, K.T. (5310200). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electron Devices (USA),* 35(11): 2052-2059 (Nov 1988).

The BNL electron gun incorporate a laser-driven photocathode in the wall of a 1 1/2 cell RF cavity operated at a peak field of 100 MV/m. Pulses of 4.5-MeV energy, 5-ps width, and 1-nC charge are produced with very little emittance growth due to the effects of space-charge and nonlinear RF fields. The design of the gun was aided by extensive computer simulation described here.

43138 Comparison of elliptical and spherical mirrors for the grasshopper monochromators at SSRL. Waldhauer, A. P. (Stanford Synchrotron Radiation Laboratory, P.O. Box 4349, Bin 99, Stanford, California 94309 (US)). *Review of Scientific Instruments (USA),* 60(7): 2109-2112 (Jul 1989). DOE Contract AC03-82ER13000.

A comparison of the performance of a spherical and elliptical mirror in the grasshopper monochromator is presented. The problem was studied by ray tracing and then tested using visible (λ=633 nm) laser light. Calculations using ideal optics yield an improvement in flux by a factor of up to 2.7, while tests with visible light show an increase by a factor of 5 because the old spherical mirror is compared to a new, perfect elliptical one. The FWHM of the measured focus is 90 μm with a spherical mirror, and 25 μm with an elliptical one. Elliptical mirrors have been acquired and are now being installed in the two grasshoppers at SSRL.

4304 Storage Rings

Refer also to citation(s) 42592, 43052, 43054, 43063, 43131, 43132, 43134, 43135, 43289

43139 (LA-UR–89-2340) **Status of PSR [Proton Storage Ring].** Macek, R.J. Los Alamos National Lab., NM (USA). 1989. 29p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-890299–16: AHF accelerator design workshop, 20-25 Feb 1989). Order Number DE89015266/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

The Los Alamos Proton Storage Ring (PSR) now operates with 35μA at 20-Hz pulse repetition rate. Beam availability during 1988 suffered because of a number of problems with hardware reliability and from narrow operating margins for beam spill in the extraction line. A strong effort is underway to improve reliability with an eventual goal of obtaining beam availability in excess of 75%. Beam losses and the resulting component activation have limited operating currents to their present values. In detailed studies of the problem, loss rates were found to be approximately proportional to the circulating current and can be understood by a detailed accounting of emittance growth in the two-step injection process along with Coulomb scattering of the stored beam during multiple traversals of the injection foil. It is now apparent that the key to reducing losses is in reducing the number of foil traversals. A program of upgrades to reduce losses and improve the operating current is being planned. 8 refs., 16 figs.

43140 (LBL–25976) **Computer-aided studies of the ALS 500 MHz storage ring cavity.** Lo, C.C.; Taylor, B. Lawrence Berkeley Lab., CA (USA). Mar 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–243: 13. particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989). Order Number DE89016343/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The design of the ALS storage ring 500 MHz cavity has been modeled with Mafia and Urmel codes. The effects of the holes cut for the drive port, the higher order mode damping port, the probe port and tuner plunger were modeled with the Mafia codes. The frequency dependence on the shape and spacing of the nose cones and the general shape of the cavity were modeled with Urmel codes. 9 refs., 7 figs., 1 tab.

43141 (LBL–25978) **Advanced light source storage ring rf system.** Taylor, B.; Baptiste, K.; Lancaster, H.; Lo, C.C. Lawrence Berkeley Lab., CA (USA). Mar 1989. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–242: 13. particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989). Order Number DE89016349/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The short electron bunch length (30ps design target) of the Advanced Light Source (ALS) stored beam is capable exciting a wide spectrum of higher order mode (HOM) frequencies. Further, the small aperture and low cut off frequency of the beam enveloping components does not allow for transmission and consequent attenuation of the lower frequency HOM components. The small cross section and divergence of the high brightness electron beam will allow for more sophisticated high resolution experiments by synchrotron radiation users. A more stringent requirement on beam position stability results, however. In this area transmitted mechanical vibration becomes a problem. The ALS RF system splits 300kW of CW 500MHz power between two single cell cavities. Compared to past practice this power rating is high. The use of only two cavities however has some advantages, it simplifies the waveguide feed system and releases room in straight sections for insertion devices, more important it reduces HOM and beam impedance problems. 3 refs., 2 figs.

43142 Development of highly polished, grazing incidence mirrors for synchrotron radiation beam lines at SSRL. Tirsell, K.G. (Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA (US)); Berglin, E.J.; Fuchs, B.A.; Holdener, F.R.; Humpal, H.H.; Karpenko, V.P.; Kulkarni, S.; Fantone, S.D. vp. of Grazing incidence optics for astronomical and laboratory applications. Bowyer, S.; Green, J.C. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8708242–: Conference on XUV optics and applications - grazing incidence optics for astronomical and laboratory applications, 16-21 Aug 1987).

New platinum-coated grazing incidence mirrors with low surface roughness have been developed to focus bending magnet radiation from the SSRL/SLAC SPEAR storage ring on the entrance slits of

two Beam Line VIII grating monochromators. The first mirror in the toroidal grating monochromator (TGM) branch is a cooled SiC cylinder capable of absorbing synchrotron radiation power levels of up to 260 watts without excessive distortion. This mirror deflects the beam vertically through a 12^0 angle and focuses it sagitally on the TGM entrance slit plane. The second TGM optical element is a fused-silica spherical mirror with a large radius of curvature that deflects the beam vertically through an additional 12^0 and focuses it tangentially with 3/1 demagnification. The first mirror in our spherical grating branch is a 5^0-vertically deflecting, cooled SiC toroid designed to focus tangentially on the monochromator entrance slits and sagitally on the exit slits. A 4^0-deflecting fused silica mirror is used after the exit slits in each beam line to refocus on to the sample. For this application a thin cylinder is bent to approximate an ellipsoid. The mirrors are now installed at SSRL and performance measurements are planned. Qualitatively the focus of the TGM optics at the entrance slit plane appears very good. In this paper the authors discuss considerations leading to the choice of SiC for each of the two first mirrors. They present highlights of the development of these mirrors with some emphasis on SiC polishing techniques. In addition, the specialized metrology developed to produce the more difficult figure of the toroid is described. Measured surface roughness and figure results are presented.

43143 Precision determination of the magnetic field in a muon storage ring using the cyclotron frequency of heavy ions - a technique for use in a new measurement of the muon g-2 value. May, M. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 279(3): 410-412 (15 Jul 1989). DOE Contract AC02-76CH00016.

A new experiment will measure the muon g-2 value with 20 times better precision than it is presently known. To reach this goal, the magnetic field in the muon storage ring must be known to one part in 10^7. This can be achieved by storing singly charged heavy ions in the ring and measuring their cyclotron frequency. (orig.).

43144 Advanced light source at Lawrence Berkeley Laboratory. Cornacchia, M. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720 (US)). *Review of Scientific Instruments (USA),* 60(7): 1388-1392 (Jul 1989).

The 1–2-GeV synchrotron radiation source will be a national user-based facility providing photon beams of unprecedented brightness in the ultraviolet and soft x-ray region of the electromagnetic spectrum. The facility design is optimized to emphasize the use of undulators to provide high-spectral brilliance in the few electron volt to 1-keV spectral range; wigglers provide high flux up to approximately 10 keV. Beam structure of a few tens of picoseconds will be available for time-resolved experiments. The facility is designed for operational flexibility and to assure rapid commissioning. The initial complement of experimental stations consists of five insertion devices (four undulators and our wiggler) and associated beamlines, and two white light beams from bend magnets. Six other straight sections are available for additional insertion devices, and the design provides for up to 48 ports for beams from bending magnets. The storage ring is optimized for operation at 1.5 GeV with a maximum energy of 1.9 GeV. The injection system includes a 1-Hz, 1.5-GeV booster synchrotron for full energy injection at the nominal operating energy of the storage ring. Filling time for the maximum stored current of 400 mA is expected to be 2 min, and the beam half-life will be about 6 h. Attention is being given to the severe requirements for beam stability and the need to independently control photon beam alignment. We describe the important characteristics of the facility, significant aspects of the technical design of accelerator systems, insertion devices and photon beamlines, and considerations related to addressing projected user needs in the development of the project.

43145 PEP as a synchrotron radiation source. Bienenstock, A. (Stanford Synchrotron Radiation Laboratory, SLAC Bin No. 69, P.O. Box 4349, Stanford, California 94309-0210 (US)); Brown, G.; Wiedemann, H.; Winick, H. *Review of Scientific Instruments (USA),* 60(7): 1393-1398 (Jul 1989).

The 16-GeV storage ring PEP has characteristics which enable it to operate in modes with very low emittance and to accommodate very long undulators, producing synchrotron radiation at x-ray wavelengths with extremely high brightness and coherent power. Two beamlines, each illuminated by a 2-m long, 77-mm period undulator magnet, are now operational and others are planned. In parasitic operation during colliding-beam runs at 14.5 GeV, these beamlines provide photons above 10 keV with a peak brightness of about 10^{16} photons/(s mm^2 $mrad^2$) within a 0.1% bandwidth. In low-emittance tests at 7.1 GeV, horizontal emittances of about 5 nm rad were measured, which is about the same as that planned for the new third-generation x-ray sources. With a current of 15 mA at 7.1 GeV, the present undulators deliver photon beams from 2.7 to 14 keV with a peak brightness of about 10^{17} . Higher performance levels are expected with the implementation of longer undulators and shorter period undulators. In the longer term, because of its large circumference and long straight sections, PEP could be further developed to achieve even higher performance levels with an emittance below 1 nm rad, very long undulators and picosecond bunches, resulting in one to two orders of magnitude higher brightness and coherent power.

43146 Observation of x-ray undulator radiation on PEP. Lavender, W. (Stanford Synchrotron Radiation Laboratory, Stanford, California 94305 (US)); Brown, G.; Troxel, T.; Coisson, R. *Review of Scientific Instruments (USA),* 60(7): 1414-1418 (Jul 1989).

A 2-m undulator magnet and associated beamline have been installed on the electron-positron storage ring PEP. The undulator is designed to produce photons at 12 keV with high intensity when the storage ring is operated at its nominal energy of 14.5 GeV. We report measurements of the spectral and angular properties of the radiation when PEP is operated in a low-emittance ($\epsilon \sim 6 \times 10^{-9}$ m rad) configuration. The spectral properties are in good agreement with theoretical predictions.

43147 Performance of a hard x-ray undulator at CHESS. Bilderback, D. H. (CHESS, Cornell University, Ithaca, New York 14853 (US)); Batterman, B. W.; Bedzyk, M. J.; Finkelstein, K.; Henderson, C.; Merlini, A.; Schildkamp, W.; Shen, Q.; White, J.; Blum, E. B.; and others. *Review of Scientific Instruments (USA),* 60(7): 1419-1425 (Jul 1989). DOE Contract W-31-109-ENG-38.

A 3.3-cm period Nd-Fe-B hybrid undulator has been designed and successfully operated in the Cornell Electron Storage Ring (CESR). This 2-m-long, 123-pole insertion device is a prototype of one of the undulators planned for the Advanced Photon Source. In dedicated operation, the undulator produced the expected brightness at 5.437 GeV with the fundamental x-ray energy ranging from 4.3 to 7.9 keV corresponding to a change in gap from 1.5 to 2.8 cm.

43148 Perspectives on the use of very long undulators in high-energy storage rings. Coisson, R. (Dipartimento di Fisica, Universita' di Parma, 43100 Parma, Italy (IT)). *Review of Scientific Instruments (USA),* 60(7): 1426-1428 (Jul 1989).

A few electron storage rings exist (and possibly could be available in the future), with energy >10 GeV and with straight sections of the order of 100 m on which very long undulators could be installed. The exceptionally low emittance that these machines can reach when run at relatively low energies would allow highly degenerate radiation to be produced in the soft and medium x-ray range, with applications to biological imaging near the C and N *K* edges, holography, and nonlinear optics down to a few angstroms, pumping of soft x-ray ion lasers, picosecond or femtosecond resolution spectroscopy, etc.

43149 Beamline 10: A multipole wiggler beamline at SSRL. Karpenko, V. (Lawrence Livermore National Laboratory, Livermore, California (US)); Kinney, J. H.; Kulkarni, S.; Neufeld, K.; Poppe, C.; Tirsell, K. G.; Wong, J.; Cerino, J.; Troxel, T.; Yang, J.; and others. *Review of Scientific Instruments (USA),* 60(7): 1451-1456 (Jul 1989).

A beamline has been constructed at Stanford Synchrotron Radiation Laboratory (SSRL) whose radiation source is a multipole permanent magnet wiggler installed in a straight section of the SPEAR 3–3.5 GeV electron storage ring. The wiggler is a hybrid design that utilizes Nd–Fe alloy magnet material combined with Vanadium Permendur poles. It is approximately 2 m long and has 15 full wiggler periods. Its field is regulated by varying its gap height. It has a peak operating field, limited by the electron beam

vacuum chamber vertical aperture, of 1.4 T. The beamline consists of vacuum, safety, and optical components capable of transporting photons to one hard x-ray (3–30 keV) end station, with provisions for implementing up to two additional branch lines. The existing hard x-ray branch can be focused by a Pt-coated toroidal mirror with a cutoff energy of approximately 22 keV. The experimental end station is serviced by a Hower–Brown type double crystal monochromator. The wiggler and beamline construction was completed in the fall of 1987 and was operated for a brief period for characterization and experimental use. We present design details and results of the initial characterization studies.

43150 Liquid gallium cooling of silicon crystals in high intensity photon beams. Smither, R. K. (Argonne National Laboratory, Argonne, Illinois 60439 (US)); Forster, G. A.; Bilderback, D. H.; Bedzyk, M.; Finkelstein, K.; Henderson, C.; White, J.; Berman, L. E.; Stefan, P.; Oversluizen, T.; and others. *Review of Scientific Instruments (USA),* 60(7): 1486-1492 (Jul 1989). DOE Contract W-31-109-ENG-38.

The high-brilliance, insertion-device-based photon beams of the next generation of synchrotron sources (Argonne's APS and Grenoble's ESRF) will deliver large thermal loads (1–10 kW) to the first optical elements. Considering the problems that present synchrotron users are experiencing with beams from recently installed insertion devices, new and improved methods of cooling these first optical elements, particularly when they are diffraction crystals, are clearly needed. A series of finite element calculations were performed to test the efficiency of new cooling geometries and various cooling fluids. The best results were obtained with liquid Ga metal flowing in channels just below the surface of the crystal. Ga was selected because of its good thermal conductivity and thermal capacity, low melting point, high boiling point, low kinetic viscosity, and very low vapor pressure. Its very low vapor pressure, even at elevated temperatures, makes it especially attractive in UHV conditions. A series of experiments were conducted at CHESS in February of 1988 that compared liquid gallium-cooled silicon diffraction crystals with water-cooled crystals. A six-pole wiggler beam was used to perform these tests on three different Si crystals, two with new cooling geometries and the one presently in use. A special high-pressure electromagnetic induction pump, recently developed at Argonne, was used to circulate the liquid gallium through the silicon crystals. In all experiments, the specially cooled crystal was used as the first crystal in a two crystal monochromator. An infrared camera was used to monitor the thermal profiles and correlated them with rocking curve measurements. A second set of cooling experiments were conducted in June of 1988 that used the intense, highly collimated beam from the newly installed ANL/CHESS undulator.

43151 Performance of a directly water-cooled silicon crystal for use in high-power synchrotron radiation applications. Oversluizen, T. (National Synchrotron Light Source, Brookhaven National Laboratory, Upton, New York 11973 (US)); Matsushita, T.; Ishikawa, T.; Stefan, P. M.; Sharma, S.; Mikuni, A. *Review of Scientific Instruments (USA),* 60(7): 1493-1500 (Jul 1989). DOE Contract AC02-76CH00016.

Results of measurements made using the multipole wiggler at beamline 16 of Photon Factory are reported. Double crystal rocking curves, Si(111) and Si(333) topographs, and thermal maps of the cooled-crystal surface were measured at total incident power levels up to 1600 W and power densities up to 0.7 W/mm^2 , for two different crystal designs. Significant crystal deformation occurred in the form of surface curvature for both designs. Finite element calculations provided a preview of the experimental results and proved very valuable in interpretation of the measurements.

43152 Micropole undulators: Novel insertion devices for synchrotron sources. Toor, A. (Lawrence Livermore National Laboratory, Livermore, California 94550 (US)); Csonka, P.; Tatchyn, R. *Review of Scientific Instruments (USA),* 60(7): 1439-1440 (Jul 1989). DOE Contract AC03-82ER13000.

Micropole undulators (wigglers) are undulators (wigglers) with submillimeter periods and are referred to, generically, as micropole insertion devices. Compared to ordinary insertion devices, whose period λ_u is typically $\geq$1 cm, micropole devices have periods smaller by a factor $f \leq 10$. Therefore, the first-harmonic radiation emitted by a micropole undulator will have its photon energy E_γ increased by f and its spectral purity $\Delta\lambda/\lambda$ by f, provided the total length of the undulator l_u stays unchanged, and magnetic field errors, as well as the electron-beam emittance, are sufficiently small. Furthermore, to generate photons of the same E_γ as from the conventional device, the electron-beam energy E_e can be reduced by $f^{1/2}$, resulting in significantly lower construction and operating costs. Radiative energy losses can be correspondingly diminished for the associated storage rings. In this paper we report on results recently obtained by us in the practical implementation and design of micropole undulators at the Stanford Synchrotron Radiation Laboratory (SSRL) and the Lawrence Livermore National Laboratory (LLNL). Based on our work, micropole undulators with $f \leq 10^4$ appear feasible at the present time.

43153 Instrumentation for millisecond-resolution scattering studies. Stephenson, G. B. (IBM Research Division, Thomas J. Watson Research Center, P. O. Box 218, Yorktown Heights, New York 10598 (US)); Ludwig, K. F., Jr.; Jordan-Sweet, J. L.; Brauer, S.; Mainville, J.; Yang, Y. S.; Sutton, M. *Review of Scientific Instruments (USA),* 60(7): 1537-1540 (Jul 1989).

Time-resolved x-ray scattering studies of phase transition kinetics have been carried out using the wide-bandpass monochromator and fast linear position-sensitive detector system at the IBM/MIT beamline X-20C at the National Synchrotron Light Source (NSLS). We report here on the instrumentation that has been developed for these studies, and in particular on the methods used to measure, change, and control sample temperature with millisecond resolution.

43154 Arc chamber deformation in small storage rings under pressure loads. Sharma, S. (National Synchrotron Light Source, Brookhaven National Laboratory, Upton, New York, 11973 (US)). *Review of Scientific Instruments (USA),* 60(7): 1775-1778 (Jul 1989). DOE Contract AC02-76CH00016.

Bending deformations of small storage ring vacuum chambers under atmospheric pressure are described. Results from a finite element model are presented which show that bending deformations due to pressure forces on metal bellows and arc chambers can cause severe misalignments at the exit ports. The deformations are shown to be larger in arc chambers of small radii. The effect of using bellows load compensators and flexible supports to reduce the deformations in an existing storage ring by an order of magnitude is evaluated by analysis and compared to actual measurements.

43155 Spectral properties of segmented undulators for the 7-GeV Advanced Photon Source. Shenoy, G. K. (Advanced Photon Source, Argonne National Laboratory, Argonne, Illinois 60439 (US)); Viccaro, P. J.; Alp, E. E. *Review of Scientific Instruments (USA),* 60(7): 1820-1823 (Jul 1989). DOE Contract W-31-109-ENG-38.

The effect of nonzero particle beam emittance and magnetic field errors on the on-axis spectral brightness (BT_0) of long undulators is discussed. It is shown that the quadratic dependence of BT_0 on the number of undulator periods, N, is reduced by emittance to N^x with $1 \leq x < 2$. Further reductions in the intensity result from random magnetic field errors present in the undulator. An approximate model for the intensity of the central core of radiation of the principle harmonics is discussed and the results compared to those from Monte Carlo-type calculations where emittance is explicitly accounted for. An estimation of the effects of random field errors on the on-axis brightness in the presence of nonzero particle emittance is made. For the particular case of undulators proposed for the 7-GeV Advanced Photon Source, the results indicate that 5-m-long devices segmented into two sections will provide the required spectral intensity of a single long undulator when both emittance and magnet errors are considered.

43156 Soft x-ray undulator for the U5 beamline at NSLS. Viccaro, P. J. (Advanced Photon Source, Argonne National Laboratory, Argonne, Illinois 60439 (US)); Shenoy, G. K.; Kim, S. H.; Bader, S. D. *Review of Scientific Instruments (USA),* 60(7): 1813-1815 (Jul 1989). DOE Contract W-31-109-ENG-38.

The magnetic structure and spectral properties of a 7.5-cm, 30-period hybrid undulator are described. The device will be installed at the U5 port of the VUV storge ring at Brookhaven National Laboratory and will be a tunable source of very high brillance soft x-ray radiation over the range of 13 to approximately 150 eV.

43157 SUNY X3 beamline at NSLS. Phillips, J. C. (Chemistry Department, SUNY Buffalo and SUNY X3 Beamline, NSLS, 725A, Brookhaven National Laboratory, Upton, New York 11973 (US)). *Review of Scientific Instruments (USA),* 60(7): 1936-1938 (Jul 1989). DOE Contract FG02-86ER45231.

The State University of New York (SUNY) beamline at National Synchrotron Light Source [NSLS] has been moved to the X3 port during the NSLS Phase II shutdown. Additional floorspace and new equipment have enabled several changes and additions to the line to be made. There will be four sets of optics with independent operation. These will feed a short wavelength crystallography station, an x-ray spectroscopy station, a time-sharing crystallography/SAXS station, and a surface science chamber. The new design of the line is presented.

43158 Compact high flux photon beam position monitor. Johnson, E. D. (National Synchrotron Light Source, Brookhaven National Laboratory, Upton, New York 11973 (US)); Oversluizen, T. *Review of Scientific Instruments (USA),* 60(7): 1947-1950 (Jul 1989). DOE Contract AC02-76CH00016.

We have developed a new compact water-cooled beam position monitor for use at the NSLS X-13 Insertion Device Development beamline, currently fitted with a high-power, high-brightness soft-x-ray undulator. We describe the novel geometry of the monitor and present the results of tests which explore its sensitivity, stability, and linearity. These results were obtained on the NSLS Beamline Research and Development white light beamline, U14B, on the VUV ring and suggest that beam position monitors of this type might be adapted to other facilities with similar spectral characteristics.

43159 Undulator heat loading studies on x-ray monochromators cooled with liquid gallium. Bilderback, D. H. (Cornell High Energy Synchrotron Source, Cornell University, Ithaca, New York 14853 (US)); Henderson, C.; White, J.; Smither, R. K.; Forster, G. A. *Review of Scientific Instruments (USA),* 60(7): 1973-1976 (Jul 1989).

Heat loading tests were conducted with up to 360 W of undulator radiation incident on liquid-gallium-cooled silicon monochromators. Rocking curve measurements and temperature profiles (infrared camera) were obtained as a function of beam current. With large heat loads, the width of the rocking curves were observed to broaden and the gain in output flux per mA of beam current was significantly less at high beam currents than during low-current operation. The best performance was obtained using a slotted crystal with cooling channels located 0.76 mm below the surface. This crystal showed strong heating effects only above 40 mA and continued to produce an increase in output flux with beam current at the highest current tested of 76 mA.

43160 Self-filtering crystal monochromators for synchrotron x radiation. Cowan, P. L. (National Institute of Standards and Technology, Quantum Metrology Division, Gaithersburg, Maryland 20899 (US)); Brennan, S. *Review of Scientific Instruments (USA),* 60(7): 1987-1990 (Jul 1989).

Monochromator crystal heating and radiation damage may be reduced significantly by reflecting much of the incident radiated power from the surface of the crystal. This requires strong Bragg diffraction of the monochromatized beam at grazing incidence angles. Examples of such cases are described, such as extremely asymmetric diffraction and grazing angle diffraction, which would permit continuously tunable x-ray energy. Additional benefits such as increased angular acceptance, variable beam cross section, adjustable bandpass, and increased flux for self-filtering monochromators are presented, and various considerations in implementation are discussed. Finally, the possibilities for exploiting the unused reflected x rays will be explored.

43161 Beamline X-11A at the NSLS: A unique facility for x-ray absorption spectroscopy. Heald, S. M. (Department of Applied Science, Brookhaven National Laboratory, Upton, New York 11973 (US)); Sayers, D. E. *Review of Scientific Instruments (USA),* 60(7): 1932-1935 (Jul 1989). DOE Contract AS05-80ER10742.

The design and operation of beamline X-11A at the NSLS is described. It employs a unique optical design using a two/four crystal monochromator and a SiC collimating mirror. In either the two- or four-crystal mode a sagittal focusing crystal allows collection of up to 5 mrad of horizontal divergence. Two techniques for rapid scanning of a sagitally focusing crystal will be described and compared. These are dynamically bending the crystal during the scan or translating a fixed radius bent crystal in a manner to maintain a fixed focus on the sample. The flexibility of this two/four crystal design allows the intensity and/or resolution of the beamline to be optimized for particular experiments.

43162 LSU Center for Advanced Microstructures and Devices. Craft, B. C. (CAMD Project Office, Louisiana State University, 60 University Lakeshore Drive, Baton Rouge, Louisiana 70803 (US)); Findley, A. M.; Findley, G. L.; McGlynn, S. P.; Scott, J. D.; Watson, F. H. *Review of Scientific Instruments (USA),* 60(7): 2144-2147 (Jul 1989).

The LSU Center for Advanced Microstructures and Devices (CAMD) is a DOE-funded materials science and engineering laboratory which will include a normal-conducting compact electron storage ring optimized for the production of soft x rays. The focus of CAMD is the fundamental study of processing and analysis technologies—including x-ray lithography—important to microstructure fabrication and electronic device development. Design details of the storage ring, which is being acquired commercially, are presented in this article.

43163 Parameter choices for the SSC. Peterson, J. M. (SSC Central Design Group (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 2240-2254 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

The design of the superconducting super collider has followed from the basic requirement that it produce observable reactions among the elementary constituents of matter at as high an energy as now possible. The basic design parameters are that proton beams of 20 TeV be brought into collision at six interaction points in such a way as to produce a luminosity of 10^{33} cm^{-2} s^{-1} per collision point. (AIP)

43164 The SSC project. Peoples, J. (SSC Central Design Group, Lawrence Berkeley Laboratory, Berkeley, California 94720 USA (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 2227-2239 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

The SSC is a 20-TeV, proton-proton collider proposed for construction by the U.S. Department of Energy (DOE). Completion is planned for the mid-1990s. A technical description of the accelerator is given along with a report on the status of the project.

43165 Feasibility study into the use of mechanical choppers to alter the natural time structure of the APS. Mills, D. M. (Advanced Photon Source, Argonne National Laboratory, Argonne, Illinois 60439 (US)). *Review of Scientific Instruments (USA),* 60(7): 2338-2341 (Jul 1989). DOE Contract W-31-109-ENG-38.

In standard operating mode, the Advanced Photon Source (APS) is projected to be with 20 equally spaced bunches of positrons separated by 177 ns. This time structure may not be optimal for all experiments, particularly those experiments that require long periods (microseconds to milliseconds) of darkness preceding and/or succeeding the x-ray burst. As a result, an ongoing study is being made into the possibility of altering the natural time structure of the x-ray bursts from the APS. One possibility is through the use of fast kicker magnets (wobblers). A more passive approach is through the use of high-speed mechanical choppers. Using choppers rotating between 18 000 and 20 000 rpm (typical rotational speeds for currently operational neutron choppers), a single burst of x rays can be passed while blocking the surrounding bursts. Interpulse periods are adjustable from approximately 3 to 300 μs depending on the slit configuration of the chopper wheels. Even longer periods of darkness can be achieved by using phased choppers and/or mechanical shutters.

44 INSTRUMENTATION

4401 Radiation Instrumentation

Refer also to citation(s) 41765, 41766, 41787, 42092, 42464, 42999, 43109, 43115, 43414, 43886, 43919, 43932, 44036, 44038, 44134, 44205

43166 (AECL–9341) **Review of tritium-in-water monitors.** Surette, R.A.; McElroy, R.G.C. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Nov 1986. 13p. Order Number DE89635583/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The current status of tritium-in-water monitors is reviewed. It is argued that the main short-coming of existing tritium-in-water monitors is imperfections in the sample delivery. Most of the liquid and solid scintillation detectors are adequately sensitive for real time monitoring applications. Although other techniques for detecting tritium-in-water are possible they all suffer from the same sample delivery problems and are either insensitive, costly, complicated or not applicable for real time monitoring. 25 refs.

43167 (AERE-M–3736) **Development of a computer program to determine the pulse-height distribution in a gamma-ray detector from an arbitrary geometry source -feasibility study.** Currie, G.D.; Marshall, M. UKAEA Harwell Lab. (UK). Environmental and Medical Science Div. Mar 1989. 17p. Order Number DE89635585/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The feasibility of developing a computer program suitable for evaluating the pulse-height spectrum in a gamma-ray detector from a complex geometry source has been examined. A selection of relevant programs, Monte Carlo radiation transport codes, have been identified and their applicability to this study discussed. It is proposed that the computation be performed in two parts: the evaluation of the photon fluence at the detector using a photon transport code, and calculation of the pulse-height distribution from this spectrum using response functions determined with an electron-photon transport code. The two transport codes selected to perform this procedure are MCNP (Monte Carlo Neutron Photon code), and EGS4 (Electron Gamma Shower code). (Author).

43168 (IFVE-OEA–88-47) **Fast recording and triggering electronics for experiments at IHEP.** Bushnin, Yu.B.; Van'ev, V.S.; Goncharov, P.I. and others. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1988. 19p. (In Russian). Order Number DE89635582/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The organization of electronic system designed for recording and fast reading out of information from multichannel detectors in experimental setups at IHEP is described. Such a structure provides possibilities to select and readout non-zero information to reduce and transmit it with 100ns/word cycle. Besides the system can produce triggering signals and output data filtration from recording electronics. 7 refs.; 6 figs.; 4 tabs.

43169 (INIS-mf–11473) **Calibration of instrument and personnel monitoring in radiological protection.** Abdul Aziz Mohamad Ramli; Wan Saffiey Wan Abdullah. Unit Tenaga Nuklear, Bangi, Selangor (Malaysia). 1987. 29p. (CONF-8711314–: Seminar on the application of nuclear techniques in industry, 17 Nov 1987). Order Number DE89635567/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI.

It is difficult to choose radioprotection equipments that are not too expensive and suit the purpose. Some of the dosimetric characteristics of good dosemeters outlined by ISO 4071-1978 (E) namely scale linearity, energy dependence, radiation quality dependence and angular dependence for some of the commercially available dosemeters are discussed. The calibration procedures practised at the National Secondary Standard Dosimetry Laboratory (SSDL), of the Nuclear Energy Unit (NEU) is also explained. The radiological equipments for personnel monitoring such as film badge and TLD are widely used to estimate the radiation dose delivered to the whole or partial body of a personnel. Both of the personnel monitoring procedures have been established at the NEU. The objective, use and maintenance of the devices are also discussed in detail. The evaluation of the monthly dose received by a personnel from various establishments in the country are also presented. (author). 17 figs.

43170 (INIS-mf–11475) **Nuclear instrument maintenance and technical training in Nuclear Energy Unit.** Mohamad Nasir Abdul Wahid. Unit Tenaga Nuklear, Bangi, Selangor (Malaysia). 1987. 17p. (CONF-8711314–: Seminar on the application of nuclear techniques in industry, 17 Nov 1987). Order Number DE89635568/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI.

Instrument maintenance service is a necessity in a Nuclear Research Institute, such as the Nuclear Energy Unit (NEU) to ensure the smooth running of our research activities. However, realising that maintenance back-up service for either nuclear or other scientific equipment is a major problem in developing countries such as Malaysia, NEU has set up an Instrumentation and Control Department to assist in rectifying the maintenance problem. Beside supporting in house activities in NEU, the Instrumentation and Control Department (I and C) is also geared into providing services to other organisations in Malaysia. This paper will briefly outline the activities of NEU in nuclear instrument maintenance as well as in technical training. (author).

43171 (INIS-mf–11483, pp. 11-12) **Dead time correction based on pulse intervals statistics.** Sabol, J. (Technical Univ., Prague (Czechoslovakia)). Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

43172 (INIS-mf–11483, pp. 15) **Detection of high energy photons using photofission method.** Reinhard, J. (Technische Univ., Dresden (German Democratic Republic)); Kadner, K.; Doerschel, B.; Streubel, G. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

43173 (INIS-mf–11483, pp. 6) **Microdosimetric model of radiation energy stock in solid detectors.** Vlasov, V.K. (Moskovskij Gosudarstvennyj Univ., Moscow (USSR)). Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

43174 (INIS-mf–11483, pp. 6) **Comparison of dosimetric properties of LiF TL detectors.** Nennemann, L. (Technische Univ., Dresden (German Democratic Republic)); Schmidt, P.; Fellinger, J.; Kaskanov, G. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

43175 (INIS-mf–11483, pp. 6) **Cosmic ray investigations on board of spacecrafts using thermoluminescent detectors.** Schmidt, P. (Technische Univ., Dresden (German Democratic Republic)); Fellinger, J.; Doerschel, B. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection*

Physics. Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
Abstract only.

43176 (INIS-mf–11483, pp. 7) **Investigations on LiF:Mg,Cu,P-TL materials.** Karpov, N.A. (Moskovskij Gosudarstvennyj Univ., Moscow (USSR)); Prokert, K.; Fellinger, J. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
Abstract only.

43177 (INIS-mf–11483, pp. 7) **Dosimetric properties of an electret ionization chamber made from polystyrene.** Seifert, H. (Technische Univ., Dresden (German Democratic Republic)); Doerschel, B.; Stoldt, C.; Prokert, K.; Schwenteck, T. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
Abstract only.

43178 (INIS-mf–11483, pp. 7-8) **Influence of environmental conditions on charge stability and dosimetric properties of electret ionization chambers.** Stoldt, C. (Technische Univ., Dresden (German Democratic Republic)); Prokert, K.; Doerschel, B.; Hanisch, S.; Pawelke, J. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
Abstract only.

43179 (INIS-mf–11483, pp. 8) **Comparison of responses of TL and SSNT neutron detectors in the cyclotron laboratory of Atomki.** Medveczky, L. (Magyar Tudomanyos Akademia, Debrecen (Hungary). Atommag Kutato Intezete); Uray, I.; Dajko, G. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
Abstract only.

43180 (INIS-mf–11483, pp. 8) **Use of semiconductor components in integrating dosimetry.** Musilek, L. (Technical Univ., Prague (Czechoslovakia). Faculty of Nuclear Science and Physical Engineering); Seda, J. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
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43181 (INIS-mf–11483, pp. 8) **Methodology of response calculations for integral neutron detectors.** Henniger, J. (Technische Univ., Dresden (German Democratic Republic)). Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
Abstract only.

43182 (INIS-mf–11483, pp. 12) **Influence of 6 MeV gamma radiation on the indication of commercial neutron measuring devices.** Horlbeck, B. (VEB Bergmann Borsig, Berlin (German Democratic Republic)); Spitzbarth, D.; Goelling, J.U. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
Abstract only.

43183 (INIS-mf–11483, pp. 14) **Dosimetric properties of TL sandwich detectors for beta and gamma rays.** Fellinger, J. (Technische Univ., Dresden (German Democratic Republic)); Huebner, K.; Schmidt, P. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
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43184 (INIS-mf–11483, pp. 14-15) **Experience in application of ultra high sensitivity TL pellets.** Niewiadomski, T. (Institute of Nuclear Physics, Cracow (Poland)); Ryba, E. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
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43185 (INIS-mf–11483, pp. 15-16) **Absorbed dose computation for material layers after irradiation with heavy charged particles.** Hahn, T. (Technische Univ., Dresden (German Democratic Republic)); Huebner, K. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
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43186 (INIS-mf–11483, pp. 18-19) **Contribution to cavity theory: calculations and experiment on dose dependence upon cavity size.** Pszona, S. (Institute for Nuclear Studies, Otwock-Swierk (Poland)). Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
Abstract only.

43187 (INIS-mf–11483, pp. 10) **Optimization of sphere detector construction to interprete neutron radiometers data in the units of equivalent dose.** Krjuchkov, V.P. (Institute for High Energy Physics, Protvino (USSR)); Lebedev, V.N.; Semjonova, G.I. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
Abstract only.

43188 (INIS-mf–11483, pp. 12) **In-situ gamma-spectrometry of transuranic radionuclides.** Sowa, W. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number

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43189 (INIS-mf–11483, pp. 13) **Radiological aspects of phosphate fertilizers production in Poland.** Olszewska-Wasiolek, M. (Institute of Nuclear Physics, Cracow (Poland)). Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
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43190 (INIS-mf–11483, pp. 15) **Calibration of a collimated gamma-ray spectrometer.** Gehrcke, K. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
Abstract only.

43191 (INIS-mf–11483, pp. 18) **High-energy neutron spectrometry in mixed undirectional fields behind accelerators shielding.** Timoshenko, G.N. (Joint Inst. for Nuclear Research, Dubna (USSR)); Krylov, A.R. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
Abstract only.

43192 (INIS-mf–11483, pp. 18) **Quality assurance of gamma-spectrometric measurements with Ge(Li)-detectors for environmental monitoring.** Knobus, B. (Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic)); Rossbander, W. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
Abstract only.

43193 (INIS-mf–11483, pp. 14) **Silicon avalanche diode as gamma-ray detector.** Vit, V. (Monokrystaly Turnov, CVUT, Prague (Czechoslovakia)); Sopko, B. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
Abstract only.

43194 (INIS-mf–11483, pp. 17) **Contribution of beta- and gamma-radiations of fallout in RTL-detectors signal.** Vlasov, V.K. (Moskovskij Gosudarstvennyj Univ., Moscow (USSR)); Fatkulbajanova, N.L. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
Abstract only.

43195 (INIS-mf–11495, pp. 34-36) **Electrostatic lenses for secondary ion mass spectrometry.** Sobhan, M.A. (Newcastle Univ. (Australia). Dept. of Physics); King, B.V. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

This paper describes a design for a high magnification 5-element electrostatic lens which focuses ions into a 90 degree spherical sector analyser. High magnification ion optics is desirable since it reduces the background signal in SIMS spectra. This allows lower concentrations of trace elements to be detected thus giving more dynamic range; gives the possibility of imaging surfaces by SIMS; allows separate ion and electron beams to be focussed on to the same area of the sample; and permits depth profiling to be done with high degree resolution without the need of raster gating. This may be important for profiling over large depths where raster gating in not desirable or possible, e.g. in sputter neutral mass spectrometry.

43196 (INIS-mf–11495, pp. 33) **Portable x-ray spectrometer.** Yoshimatsu, Mitsuru (Rigaku Denki Co. Ltd., Tokyo (Japan)); Kennard, C.H.L. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.
Abstract only.

43197 (INIS-mf–11495, pp. 43-45) **New technique for measuring spontaneous fission half lives.** Hines, M.G. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)); Boldeman, J.W. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

In general, a spontaneous fission half life measurement involves determining the mass of the spontaneously fissioning isotope present, and the associated fission rate. Although the mass of the isotope can be measured with high accuracy and relative ease, the fission rate measurement is far more difficult. Measurement of the fission rate has, in the past, always involved direct fragment counting using some form of gas-filled ionisation chamber. For isotopes with very long spontaneous fission half lives ($>10^{10}$ years) this becomes difficult because of alpha pile-up within the ionisation chamber. To overcome this, we propose a technique based the detection of the neutrons emitted in spontaneous fission. This technique is an extension of our safeguards instrumentation program. In particular, the basic technique is utilised in a prototype safeguards instrument for the non-destructive assay of plutonium.

43198 (INIS-mf–11495, pp. 197-198) **Low level gamma spectrometry by high speed digital sampling.** McMillan, P.T. (New South Wales Univ., Kensington (Australia). School of Physics); Kelly, J.C. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Thermoluminescent dating usually involves estimation by dosimetry of environmental radiation. We use a NaI(Tl) crystal detection system in a massive Pb and Fe castle. Signal conditioning involves the usual preamplification, pulse shaping, discrimination and dedicated MCA. The successful use of a Phoswich detector (NaI(Tl) + CaF2(Eu)) for beta/gamma discrimination usually involved further stages of pulse processing and manipulation relying on the different pulse shape characteristics resulting from the different scintillator relaxation times (250 ns and 1000 ns respectively). The prospect of needing several NIM racks (Nuclear Instrument Modules) packed with various modules, all of which require tuning, has induced us to have another look at the overall problem of data collection and data analysis for low-level gamma counting, i.e. one event per second.

43199 (INIS-mf–11495, pp. 129) **Industry perspective on nucleonic instrumentation.** Howarth, W.J. (Mineral Control Instrumentation Pty. Ltd., Unley SA (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Abstract only.

43200 (INIS-mf–11989, pp. 223) **Multiplexed fibre optic spectrophotometry for in-line process analysis.** Sym, G.J. (UKAEA Dounreay Nuclear Power Development Establishment, Thurso (UK)); Williams, P.S. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

43201 (INIS-mf–11989, pp. 223) **H3 and C14 air monitoring according to KTA 1503.1.** Bruessermann, K. (Bonnenberg und Drescher Ingenieurgesellschaft m.b.H., Aldenhoven (Germany, F.R.)). Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

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43202 (INIS-mf–11989, pp. 223) **An in-beam Compton-suppressed Ge spectrometer for non-destructive neutron activation analysis.** Zaghloul, R. (Atomic Energy Establishment, Cairo (Egypt). Hot Lab. Center); El-Haleem, A.A.; Ache, H.J.; Mostafa, M. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

43203 (INIS-SU–98, pp. 162) **Using automated spectrometer with semiconductor detector in nuclear-physics experiments.** Kazak, L.A.; Kosse, A.I.; Shkola, N.F. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

Short note; 3 refs.

43204 (INIS-SU–100, pp. 127-129) **Measurements of the decay constants by the convolution method.** Gopych, P.M. (Khar'kovskij Gosudarstvennyj Univ., Kharkov (Ukrainian SSR)); Demchenko, M.N.; Zalyubovskij, I.I.; Sotnikov, V.V. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The device to measure the lifetime (decay constants) by the convolution method in experiments with the background is described. The technique of measuring the lifetime by the convolution method is presented and the examples of its application for background measurements are given. The efficiency of using the above technique and the device developed to measure the lifetime of nuclei composing radioactive sources of complex isotopic composition is shown. The procedure of calculating the errors of lifetime values found is discussed, the results of the convolution method and those obtained by conventional technique, are compared. 3 refs.; 3 figs.

43205 (INIS-SU–100, pp. 136-138) **Comparison of the programmes for computerized determination of the peaks in the line spectra.** Gopych, P.M. (Khar'kovskij Gosudarstvennyj Univ., Kharkov (Ukrainian SSR)); Zalyubovskij, I.I. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The technique of the objective quantitative comparison of peak searching programs based on the calculation of the conventional probability of the true peak detection D in cases of fixed and similar value of conventional probability of their false detection F for the programs considered, is suggested. The technique and the procedure of comparing the quality of peaksearch programs is described and the results of comparison of the known programs of peak identification are given. 11 refs.; 1 fig.

43206 (INIS-SU–100, pp. 139-142) **Calculation of the potential precision of the peaks parameters determination by the maximum likelihood fit.** Gopych, P.M. (Khar'kovskij Gosudarstvennyj Univ., Kharkov (Ukrainian SSR)). AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

General expressions to calculate potential errors when determining peak parameters from the composition of multiplets of any complexity are obtained by the maximum likelihood fit within the framework of the linear stochastic spectrum model suggested. The formulae for potential errors in the determination of single peak parameters are obtained from the general expressions for the simpliest partial case, i.e. single peak (singlet) on the constant background. These formule are compared with the empirical formulae. It is shown that all results agree within the range of their application. 3 refs.

43207 (INP–1302/PS, pp. 21-46) **NORD BALL - an effective system for the detection of gamma radiation in nuclear reactions.** Ryde, H. (Lund Univ. (Sweden). Dept. of Cosmic and Subatomic Physics). Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

The recent development of efficient detector systems mainly for gamma-ray spectroscopy is discussed and the ideas behind the NORD BALL project, which is a joint Nordic effort to design and construct such an effective and versatile detector system intended for use in experiments at different accelerator laboratories is presented. A few words about the accelerator situation in the Nordic countries is said so as to give you a background for the possible future experiments with the use of the NORD BALL detector system. 6 refs., 12 figs., 2 tabs. (author).

43208 (INS–739) **Broad range spectrometer PIK for medium-energy meson spectroscopy.** Akei, M.; Amann, J.F.; Chiba, J. and others. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Mar 1989. 38p. (OULNS–88-11). Order Number DE89906505/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A broad range spectrometer PIK has been constructed for the study of Λ hypernuclei via the (π^+, K^+) reaction. The spectrometer can be also used for nuclear spectroscopy with medium-energy meson beams. It consists of two independent spectrometers: one

analyzes the incident beam momentum, and the other determines the momentum of the scattered particle. The latter spectrometer is characterized by a large solid angle of 15 - 22 msr, a broad range momentum acceptance of 0.55 - 1.1 GeV/c, a wide angular acceptance of 11deg, and a short flight path length of 4.5 m. The scattered particle is identified by the use of silica aerogel Cerenkov counters and lucite Cerenkov counters and by measuring its time-of-flight. Performance of the spectrometer is examined by the (π^+, K^+) reaction on ^{12}C target at P_π = 1.05 GeV/c and by the (π^+, P) reaction on a CH_2 target. (author).

43209 (ISN–88-101) **Realization of an apparatus for the synthesis and detection of carbon 11 labelled fatty acids and of a data acquisition system for the study of the myocardial methabolism of radiopharmaceuticals.** Fressonnet, G. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. 1988. 260p. (In French). Order Number DE89908212/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

This thesis describes the study and the realization of an apparatus to synthesize fatty acids labelled with carbon 11, a radioactive isotope with an half-life of 20.38 minutes. A system of gamma-ray detection with data processing designed for the study of the myocardiac metabolism of radiopharmaceuticals using isolated rat hearts as experimental models. The synthesis of carbon 11 labelled fatty acids required a preliminary study of the manufacture of this isotope at the synchrocyclotron of the I.P.N. (Lyon). The method chosen is the nuclear reaction (d,xn) with naturally occurring boron trioxide as the target. The apparatus was designed so as extract carbon 11 from the target in the form of $^{11}CO_2$ which can then be used in the synthesis of carbon 11 labelled hexadecanoique, heptadecanoic and beta-methyl hexadecanoic acids. The time scale of this synthesis must be compatible with the short half-like of the isotope. In order to study these compounds 'in vivo' on the experimental model of isolated rat hearts, a system of detection, which functions either in a simple gamma mode or in a gamma-gamma coincidence mode, was developed. This apparatus can attain a rate of approximately 50 000 counts/sec. per channel, thus it is possible to obtain information about rapid phases of metabolism with a satisfactory statistical precision. Moreover the spectral analysis of the gamma-ray permits the simultaneous detection of different radioisotopes. Hence it was possible to compare the behaviour of carbon 11 labelled fatty acids with homologous molecules marked with iodine 123. The analysis of the experimental results was achieved witha computer based on an I.B.M. compatible PC-XT. The essential parts of this system are a data-acquisition card for the PC, code for the acquisition and the data processing.

43210 (ITEF–25(1988)) **Performance of gamma detectors on base of microchannel electron multipliers at low temperatures.** Alpatov, V.G.; Davydov, A.V.; Konyaev, V.F.; Korotkov, M.M.; Kostina, G.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1988. 12p. (In Russian). Order Number DE89635586/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Results of experiments on detecting gamma-quanta in 14.4-661.6 keV range using detectors comprising two microchannel domestic production 34mm diameter plates in a chevron-type composition are described. The detectors operate well at indoor and low temperatures down to 4.2 K. Data on count number dependence on the voltage on the detector both for background and noise pulses and signals conditioned by gamma-quanta are presented. On comparing amplitude pulse spectra conditional by different energy gamma quanta it is determinated that lower energy photon detection leads to a higher mean pulse amplitude. 2 refs.; 6 figs.

43211 (ITEF–27(1988)) **Efficiency of gamma detection at different energies by the detector on base of microchannel electron multipliers at low temperatures.** Alpatov, V.G.; Davydov, A.V.; Korotkov, M.M.; Kostina, G.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1988. 13p. (In Russian). Order Number DE89635587/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Results of measuring the detection efficiency of gamma-quanta with different energy using a standard domestic production chevron-type assembly of 2 microchannel plates 32-12 at indoor and low (173K) temperatures are presented. Observed qualitative similarity od dependences of gamma-quantum detection efficiency using a detector and complete secondary fast electron yield on the energy testifies to the fact that detection efficiency is mainly determined by secondary electron yield. Efficiency decrease under cooling down to 173 K is insufficient and makes up several per cent for a wide energy interval. Noises for the given assembly are about 150 times reduced. 14 refs.; 4 figs.

43212 (KEK–88-9, pp. 127-143) **Chopper spectrometers at the ISIS facility.** Taylor, A.D. (Rutherford Appleton Lab., Chilton (UK)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8710488–: Workshop on neutron scattering research with intense spallation neutron source, 6-7 Oct 1987). In *Proceedings of the workshop on neutron scattering research with intense spallation neutron source 'today and tomorrow'. First meeting of Japan-UK collaboration in neutron scattering research.* Order Number DE89906380/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

The report describes the performance of the High Energy Inelastic Spectrometer HET at ISIS and gives some rational behind the design of its sister spectrometer MARI which is being built. The HET spectrometer is a direct geometry chopper spectrometer designed specifically to study systems at high energy transfer ϵ with low associated momentum transfer Q and good energy transfer resolution $\Delta\epsilon$. This is achieved by monochromating at high incident energies (100 $\sim$ 2000 meV) and scattering at low angles (3 $\sim$ 30deg). In the spectrometer, the standard ISIS primary collimation system is used which consists of B_4C beam-defining irises alternating with borated-resin/iron-shot spacers. After the monochromating chopper, a further set of B_4C irises (which can be easily changed) limits the beam area to 5 x 5 cm^2 and prevents the lowest angle detectors from directly viewing the chopper. The monochromating chopper, located 10 m from the source, spins on magnetic bearings at frequencies up to 600 Hz and produces a sharp ($\sim$1 μs) burst of neutrons on the sample. The background supressing chopper blocks the beam during the power pulse with 30 cm long bar of nimonic alloy 6 x 6 cm^2 in cross-section and prevents fast neutrons from entering the spectrometer. Scattered neutrons are detected 4 m from the sample in a low angle array (3 $\sim$ 7deg) of ^3He gas tubes, at 4 m in a high angle array (136deg) and at 2 m in an intermediate angle array (10 $\sim$ 30deg). (Nogami, K.).

43213 (KEK–88-9, pp. 144-161) **Chopper spectrometer INC ad KENS.** Arai, Masatoshi (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)); Watanabe, Noboru; Ikeda, Susumu; Kohgi, Masahumi; Itoh, Masayuki; Iwasa, Hirokatsu; Endoh, Yasuo. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8710488–: Workshop on neutron scattering research with intense spallation neutron source, 6-7 Oct 1987). In *Proceedings of the workshop on neutron scattering research with intense spallation neutron source 'today and tomorrow'. First meeting of Japan-UK collaboration in neutron scattering research.* Order Number DE89906380/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

The report discusses a spectrometer called INC, which is under construction at the KENS, aiming at neutron scattering with the energy transfer from 20 to 1000 meV and the momentum transfer from 0.3 to 40 A^{-1}. The most important problem in designing the spectrometer was the restriction of the available space in the experimental hall. Only 7m was available for the flight path out of the bulk shield of 4m thick. An effort was made to find optical parameters to achieve better performances under this restriction. Taking into account the actual constraint, it was decided to adopt a horizontal layout rather than a vertical one and the parameters L1=7m, the distance between moderator and monochromating chopper, L2=1.3 or 2.5m, between sample and detector, and L3=1m, between chopper and sample. L2 is 2.5m for the scattering angle 5-40deg, while 1.3m for 40-130deg. These parameters satisfy most of the required performances. The monochromating chopper is almost the same as that of the MARI. To supress delayed fast neutrons from the uranium target as well as fast burst neutorns, a background supression

chopper is indispensable for INC. A mechanical chopper system is currently under development for this purpose. The inner collimator in the bulk shield and the outer collimator between two choppers consist of sintered B_4C, steel and borated resin (boric-acid 40%, polyethylene-beads 40%, epoxy-adhesive 20% in weight) making an image 6 x 6 cm^2 at the sample position. (N.K.).

43214 (KEK–88-9, pp. 197-201) **Polarized white neutron diffraction at PEN spectrometer.** Ohoyama, K. (Tohoku Univ., Sendai (Japan). Dept. of Physics); Fujimoto, H.; Kohgi, M. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8710488–: Workshop on neutron scattering research with intense spallation neutron source, 6-7 Oct 1987). In *Proceedings of the workshop on neutron scattering research with intense spallation neutron source 'today and tomorrow'. First meeting of Japan-UK collaboration in neutron scattering research.* Order Number DE89906380/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

The Polarized Epithermal Neutron Spectrometer PEN at KENS is designed to utilize the polarized white (thermal to epithermal) neutrons for the studies of the scattering phenomena which depend on the incident neutron polarization. The neutron polarization is achieved by passage through a dynamically polarized proton filter (DPPF). The present study aims to measure the magnetization of γFeNi alloy ultra fine particles UFP by polarized neutron diffraction technique in order to investigate the size effect on the Invar anomaly as the particle size becomes very small. From the relations for the intensities of the Bragg peaks for polarized neutrons, it is derived that $(I^+ + I^-)$ and $(I^+ - I^-)$ are proportional to $2(b^2+P^2)$ and $4bpP$, respectively, where b is the nuclear coherent scattering length, $p = (\gamma e^2/2mc^2)\mu f(k)$ the magnetic scattering length, μ the magnetic moment per atom, f(k) the magnetic form factor, and P the neutron polarization. The first relation corresponds to unpolarized neutron diffraction, and the second, which corresponds to the coherence between the nuclear and magnetic scattering, is useful for determination of the magnetic moment of atoms. The magnetic moment per atom of γFeNi UFP is obtained by fitting the above relations to the sum and difference of the observed I^+ and I^- data by the profile fitting (Riedveldt) technique. The magnetic moments of γFeNi UFP are found considerably larger than those of the bulk alloys. (N.K.).

43215 (KIYI–88-11) **$CdWO_4$, ZnSe, $ZnWO_4$ for investigations of 2 β processes.** Danevich, F.A.; Zdesenko, Yu.G.; Nikolajko, A.S. and others. AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. 19p. (In Russian). Order Number DE89635573/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

It was studied and improved the spectrometric characteristics of scintillators $CdWO_4$, ZnSe, $ZnWO_4$ by means of which the search of 11 double-beta transitions of isotopes Zn,Cd,Se,W may be carried out. From the preliminary measurements of background $CdWO_4$ the limits of half-life period of ^{186}W, ^{114}Cd, ^{116}Cd were established with respect to neutrinoless mode of double-beta decay correspondently equal to $9x10^{18}$, $1x10^{19}$ and $1,3x10^{19}$ years. The possibilities of sensitivity increase of experiments on double-beta decay up to level of 10^{22} years were estimated. 10 refs.; 5 figs.; 6 tabs.

43216 (LA-UR–89-2375) **Monte Carlo calculations of the vacuum Compton detector sensitivities.** Hsu- Hsiao-Hua; Lee, Huan. Los Alamos National Lab., NM (USA). 1989. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890723–12: 26. annual conference on nuclear and space radiation effects, Marco Island, FL (USA), 24-28 Jul 1989). Order Number DE89015263/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Monte Carlo simulations have been carried out to compute the static sensitivity of the vacuum Compton detector for monoenergetic gamma rays and electrons. A similar calculation using ^{60}Co spectrum as input is found in good agreement with measurements. We also calculate the detector sensitivities for bremsstrahlung spectra produced by monoenergetic e-beam and compare with experimental data. 8 refs., 6 figs.

43217 (LA-UR–89-2382) **Working with some of the newer high-Z scintillators.** Laros, J.G. Los Alamos National Lab., NM (USA). [1989]. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890836–3: 33. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering, San Diego, CA (USA), 6-11 Aug 1989). Order Number DE89015261/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have performed simple laboratory studies of several of the newer high-Z inorganic scintillators, with a primary goal of evaluating their relative merits as sensors for space-borne instruments. It is appropriate to consider using one of these materials when light output can be exchanged for some other beneficial property, such as higher stopping power (bismuth germanate), superior resistance to radiation damage (barium fluoride), or fast decay time (barium fluoride and pure cesium iodide). Our work has revealed or confirmed important characteristics – both favorable and unfavorable – of these newer scintillators. For example, the temperature dependence and particle species dependence of the fast and slow scintillation output of barium fluoride and pure cesium iodide will be described. 6 refs.

43218 (LA-UR–89-2404) **Report on the performance and operating characteristics of the Burle C83061E QUANTACON™ photomultiplier tube.** Sandberg, V.D.; Thompson, T.N.; Helvy, F.A. Los Alamos National Lab., NM (USA). 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8905193–1: Workshop on physics and experimental techniques of high energy neutrinos and VHE and UHE gamma-ray particle astrophysics, 11-13 May 1989). Order Number DE89015257/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Burle C83061E QUANTACON™ is a 10.4 inch diameter photomultiplier tube with improved photoelectron collection optics. We report here on the first tests of this newly developed tube. We find the single photoelectron charge resolution to be excellent, with a peak to (noise) valley ratio exceeding 3 and with a transit time spread of less than 2.3 ns (FWHM) for full photocathode illumination at the single photoelectron level. A design for a fast anode pulse base is also presented. 11 refs., 8 figs.

43219 (LBL–27327) **Nonuniformities in organic liquid ionization calorimeters.** Wenzel, W.A. Lawrence Berkeley Lab., CA (USA). Jun 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890379–13: Workshop on calorimetry for the SSC, Tuscaloosa, AL (USA), 13-17 Mar 1989). Order Number DE89015346/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Hermeticity and uniformity in SSC calorimeter designs are compromised by structure and modularity. Some of the consequences of the cryogenic needs of liquid argon calorimetry are relatively well known. If the active medium is an organic liquid (TMP, TMS, etc.), a large number of independent liquid volumes is needed for safety and for rapid liquid exchange to eliminate local contamination. Modular construction ordinarily simplifies fabrication, assembly, handling and preliminary testing at the price of additional walls, other dead regions and many nonuniformities. Here we examine ways of minimizing the impact of some generic nonuniformities on the quality of calorimeter performance. 6 refs., 7 figs.

43220 (LBL–27457) **Applications of a-Si:H radiation detectors.** Fujieda, I.; Cho, G.; Conti, M.; Drewery, J.; Kaplan, S.N.; Perez-Mendez, V.; Qureshi, S.; Street, R.A. Lawrence Berkeley Lab., CA (USA). Jul 1989. 25p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890861–1: 13. biennial international conference on amorphous and liquid semiconductors (ICALS-13) and the first international conference on amorphous semiconductor technology (ICAST-1), Asheville, NC (USA), 21-26 Aug 1989). Order Number DE89015230/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Device structures and operation principles are described for detecting various kinds of radiation with hydrogenated amorphous silicon (a-Si:H) layers. With some new configurations such as the buried p-i-n structure and the use of interdigitated electrodes, the a-Si:H radiation detectors will find their applications in many fields of science. Some applications in high energy physics, medical imaging, materials sciences and life sciences are discussed in this paper. 41 refs., 7 figs., 1 tab.

43221 (LYCEN–89-03) **Using the combination CsI(Tl) + photodiode for identification and energy measurement of light particles.** Guinet, D.; Chambon, B.; Cheynis, B.; Demeyer, A.; Drain, D.; Hu, X.C.; Pastor, C.; Vagneron, L.; Zaid, K.; Giorni, A. Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire. 1989. 6p. Order Number DE89908106/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

The feasibility of discriminating light charged particles in charge and mass using the CsI(Tl) + photodiode combination is demonstrated. Experiment layout and results for a test using a beam of 30 MeV/nucleon α particles impinging on self-supporting gold and aluminium targets are shown.

43222 (NCS-R–3) **Proceedings of the symposium on thermoluminescence dosimetry.** Aalbers, A.H.L. (National Institute of Public Health and Environmental Protection, Bilthoven (Netherlands)); Bos, A.J.J. (Interuniversitair Reactor Inst., Delft (Netherlands)); Mijnheer, B.J. (Nederlands Kanker Inst. 'Antoni van Leeuwenhoekhuis', AmsterdamNederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. 152p. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Includes index of authors.

In thi proceedings volume papers have been collected dealing with theoretical and practical aspects of thermoluminiscence dosimetry (TLD). (H.W.).

43223 (NCS-R–3, pp. 79-84) **Thermoluminescence dosimetry at Eindhoven University of Technology.** Hemelaar, J.T. (Eindhoven University of Technology (Netherlands). Health Physics Division); Kicken, P.J.; Huyskens, C.J. Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on thermoluminescence dosimetry.* Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Includes index of authors.

This paper gives an outline of organizational aspects and technical features of the thermoluminiscence dosimetry system of the eindhoven University of Technology. (H.W.). 3 figs.

43224 (NCS-R–3, pp. 5-15) **Mechanisms of thermoluminiscence production in LiF:Mg,Ti (TLD-100).** Bos, A.J.J. (Interuniversitair Reactor Inst., Delft (Netherlands)). Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on thermoluminescence dosimetry.* Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Includes index of authors.

Lithium fluoride with magnesium and titanium and available under the name TLD-100 is one of the most popular thermoluminiscent (TL) materials used in radiation dosimetry. In this review the mechanism is described of TL production in TLD-100 from the viewpoint of the user. (H.W.). 17 refs.; 6 figs.; 1 tab.

43225 (NCS-R–3, pp. 17-24) **Some experimental observations on the supralinearity of the response of TLD-100 in the radiotherapeutic dose range.** Mijnheer, B.J. (Nederlands Kanker Inst. 'Antoni van Leeuwenhoekhuis', Amsterdam (Netherlands)); Weeda, J. Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on thermoluminescence dosimetry.* Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Includes index of authors.

In order to obtain a high decree of accuracy (<=5%, one standard deviation) when using thermoluminiscence dosimetry (TLD) in the clinic, a number of tests is required, of which one refers to the relationship between dose and TLD reading. Supralinearity in the response of several TLD materials occurs at doses above a few Gy. For LiF TLD-100, onset values of thermoluminiscence supalinearity varying from 1 to 10 Gy have been reported. In this contribution the results of measurements are described of supralinearity for the response of TLD-100 at doses below 5 Gy using different read-out and different annealing procedures. (H.W.). 11 refs.; 4 figs.

43226 (NCS-R–3, pp. 25-30) **Supralinearity and dependence on energy of LiF 700 powder response for photons and electrons.** Marijnissen, J.P.A. (Dr. Daniel den Hoed Cancer Centre, Rotterdam (Netherlands)); Goebel, B. Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on thermoluminescence dosimetry.* Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Includes index of authors.

Thermolumiscence dosimetry (TLD) using LiF 700 powder is applied for the measurement of dose distributions in phantoms as well as patients. The LiF powder is calibrated against a 0.6 cms thimble ionization chamber in a 4 MV photon beam at a reference test dose of 1 Gy. The TL response/unit dose is considered as the calibration factor for this particular dose and radiation quality. TL-response to dose conversion for TLD measurements at other radiation qualities and doses requires adequate knowledge of the TL properties of the TL-material, i.e. the supralinearity and dependence on energy of the LiF 700 response. Supralinearity and energy dependence for average photon energies of 45 keV - 12 MeV and for electrons with initial energies of 4-32 MeV have been studied. In this paper preliminary results are given with emphasis on the difference in response in high energy electrons and high energy photon beams. (H.W.). 10 refs.; 2 figs.; 1 tab.

43227 (NCS-R–3, pp. 31-36) **Computerized analysis of glow curves from LiF:MgZTi (TLD-100).** Vries, W. de (Interuniversitair Reactor Inst., Delft (Netherlands)); Hoogenboom, J.E.; Dilehof, J.B.; Bos, A.J.J. Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on thermoluminescence dosimetry.* Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

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Computerized glow curve analysis is an advanced technique used to study various parameters associated with the charge transfer that occurs during thermoluminescence emission. A computer program has been developed to analyze complex glow curves, based upon a non-linear least-squares program. The program decomposes a measured glow curve into a number of different glow peaks, each of them described by four physical parametres of the thermoluminescence (TL)-process involved: the order of kinetics of the process, the trap depth, a frequency factor, and the number of traps. In this study the applicability of this computer program for analyzing glow curves of LiF: Mg, Ti (TLD-100) in routine dosimetry has been investigated. A prerequisite using computerized glow curve analysis in routine TL dosimetry is a model of the TL-process that describes the shape of the glow curve exclusively in terms of the dose, i.e. a model which is independent of the experimental and/or radiation field parameters. In this investigation the constancy of the various model parameters for differnt radiation types, energies and doses are studied. (H.W.). 11 refs.; 3 figs.; 2 tabs.

43228 (NCS-R–3, pp. 37-42) **Carbon loaded dosemeters for the measure of the shallow dose equivalent due to beta-radiation.** Preston, H.E. (Vinten Instruments Ltd., Weybridge (United Kingdom)). Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on thermoluminescence dosimetry.* Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

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A type thermoluminiscence dosemeter is presented which is phycically thick enough for ease of handling and length of useful life, while it behaves to radiation as if it where thin. (H.W.). 4 refs.; 3 figs.; 1 tab.

43229 (NCS-R–3, pp. 43-48) **Does the most sensitive thermoluminiscent material come from China?. Some characteristics of LIF: Mg.Cu.P (GR-200) TL chips.** Bos, A.J.J. (Interuniversitair Reactor Inst., Delft (Netherlands)); Dielhof, J.B. Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on thermoluminescence dosimetry.* Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

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Presented are the results of a study of some dosimetric characteristics of chip consisting of solid LiF phosphor activated with Mg, Cu and P, a highly sensitive thermoluminiscence (TL) material (GR-200 chips), in order to verify the claims of the manufacturer. (H.W.). 8 refs.; 4 figs.; 4 tabs.

43230 (NCS-R–3, pp. 51-60) **TNO individual monitoring service based on TLD concepts and methodology.** Julius, H.W. (TNO, Netherlands Organization for Applied Scientific Research, Arnhem (Netherlands) Radiological Service TNO); Busscher, F.A.I.; Verhoef, C.W. Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on thermoluminescence dosimetry.* Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

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A general description is given of the dosimetric concepts in todays Individula Monitoring on which the TNO thermoluminiscence dosimetry (TLD) system is based. Some technical details of the TLD system itself are given. (H.W.). 10 refs.; 6 figs.; 1 tab.

43231 (NCS-R–3, pp. 65-69) **ECN-neutron-beta-gamma dosimeter. Theory and practice.** Keverling Buisman, A.S. (Netherlands Energy Research Foundation, Petten (Netherlands)). Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on thermoluminescence dosimetry.* Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

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This paper discusses the theory and practice of a new type dosimeter which is sensitive to neutron, beta and gamma radiation. This dosimeter is based upon thermoluminescent techniques and allows full automatization of readout and storage results. (H.W.). 2 figs.; 1 tab.

43232 (NCS-R–3, pp. 71-78) **Environmental radiation monitoring using thermoluminiscence dosemeters.** Aalbers, A.H.L. (National Institute of Public Health and Environmental Protection, Bilthoven (Netherlands)); Bader, F.J.M.; Lunenburg, A.P.P.A. van; Kuile, C.R. ter. Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on thermoluminescence dosimetry.* Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Includes index of authors.

he performance of thermoluminiscence (TL) dosemeters under laboratory and field measurement conditions can be improved by experience gained in participating in international intercomparisons and from standardization studies. In this paper the set up and processing of the thermoluminiscence devices used in a intercomparison study is briefly described as well as some aspects of the readout technique, calibration procedure and temperature related effects. Some preliminary results from environmental measurements performed with TL-dosemeters and a high pressure ionization chamber are reported. (H.W.). 4 refs.; 5 figs.

43233 (NCS-R–3, pp. 85-91) **Environmental and calamity TLD-systems around Dutch nuclear power stations.** Velzen, L.P.M. van. Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on thermoluminescence dosimetry.* Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

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In 1981 a research project was initiated at the KEMA department of Environmental Research, concerning a new environmental thermoluminiscence dosimetry (TLD) system. This project consisted of several parts: - requirements of the TLD-system - a comparative study of commercially available TLD-materials - evaluation of a measureing procedure for a routine monitoring programme. On the basis of the reslts of this project, KEMA advised the nuclear power stations to perform their environmental monitoring with a combination of a CaF 2 TLD's (Harshaw's TLD-200) and the automatic TNO TLD-reader. The next step in the development was to turn the laboratory set-up into an operational TLD-system. The development included the design of new TLD-holders. T D pick-out platforms, a readout table, electronics, automation of the TLD readout cycle, and automation of the data manipulation. (author). 4 figs.

43234 (NCS-R–3, pp. 101-107) **TL-dosimetry in clinical practice.** Bakker, D. (Catharina Hospital, Eindhoven (Netherlands). Radiotherapy Department); Crommelin, M.A.; Dries, W.J.F. Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on thermoluminescence dosimetry.* Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

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At the Radiation Therapy Department of the Hospital thermoluminescence is used for dosimetric studies with phantoms, in-vivo dosimetry and radiation protection measurements. This paper is an overview of the materials and methods used. A few applications are illustrated and some results are presented. (H.W.). 5 refs.; 6 figs.

43235 (NCS-R–3, pp. 109-114) **Application of TLD for determination of dose distributions for photon irradiations in radiobiology.** Zoetelief, J. (Radiobiological Institute TNO, Rijswijk (Netherlands)); Wit, N.J.P. de. Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on thermoluminescence dosimetry.* Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

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Examples of dose distributions measured with thermoluminiscence dosimetry are given for partial and whole body irradiation of rats in radiobiological studies and compared with the results of the use of ionization chambers. (H.W;). 6 refs.; 2 figs.; 2 tabs.

43236 (NCS-R–3, pp. 115-119) **Response of ^{7} LIF thermoluminiscent dosimeters to clinical neutron beams with energies ranging from d(14)+Be to p(75)+Be.** Vynckier, S. (UCL-CLiniques Universitaires St. Luc, Bruxelles (Belgium)); Wambersie, A.; Hocini, B. Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on thermoluminescence dosimetry.* Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

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The relative sensitivity of thermoluminiscent dosimeters (TLD) is defined as the ratio of the sensitivity of the TLD to neutrons and the sensitivity of the TLD to Co-60 photons. In this paper the variation of the relative sensitivity of Lithium-7 Fluoride (TLD700) as a function of the neutron energy and the depth of irradiation in a phantom is studied. (H.W.). 10 refs.; 3 figs.

43237 (NCS-R–3, pp. 121-127) **Dosimetry in a mixed (14.8 MeV neutron, gamma) radiation field with CaF 2: (TLD-300).** Dielhof, J.B. (Interuniversitair Reactor Inst., Delft (Netherlands)); Bos, A.J.J.; Zoetlief, J.; Broese, J.J. Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on*

thermoluminescence dosimetry. Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.
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The relative neutron and gamma ray sensitivities of the glow peaks of CaF_2: Tm (TLD-300) have been determined and the applicability and limitations of the two-peak method with CaF_2: Tm (TLD-300) has been studied in a mixed (14.8 MeV neutron, gamma) radiation field. (H.W). 9 refs.; 2 figs.; 1 tab.

43238 (NCS-R-3, pp. 129-134) **TLD using LiF powder applied in radiotherapy. Pratical aspects and results.** Marijnissen, J.P.A. (Dr. Daniel den Hoed Cancer Centre, Rotterdam (Netherlands)); Goebel, B. Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on thermoluminescence dosimetry.* Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.
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The precision of thermoluminiscence dosimetry with LiF 700 powder at radiotherapy dose levels (0.1 - 15 Gy) is evaluated. (H.W.). 1 ref.; 3 figs.

43239 (NCS-R-3, pp. 135-140) **Eighteen months of clinical TLD-dosimetry. Equipment, calibration, and annealing procedures, reproductability and applications in radiotherapy.** Van Loon, R. (Vrije Universiteit Brussel (Belgium). Akademisch Ziekenhuis, Departement Radiotherapie); Schaeken, B.; Coppens, L.; Van Lancker, M.; Goor, C. Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on thermoluminescence dosimetry.* Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.
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It is assessed if a not specialized laboratory could obtain with commercial equipments (Mg and Ti doped ^{7} LiF thermoluminiscence dosimeters) a reproducable and accurate dose determination in both reference and clinical conditions. (H.W.). 5 refs.; 5 fig.; 3 tabs.

43240 (PNL–6500-Pt.4, pp. 36-37) **Microdosimetry detector development.** Braby, L.A.; Metting, N.F. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

A very small detector is needed for heavy ion radial distance microdosimetry since a small detector makes it possible to simulate somewhat smaller site sizes while maintaining secondary charged particle equilibrium in a vacuum chamber of reasonable size. The smaller actual size of the detector also allows it to measure energy deposition in volumes situated over a wider range of distances from the path of the primary heavy ion than was possible before. The other type of microdosimetric measurement in which a smaller configuration is important is that of accelerator-produced neutrons. Because the energy and fluence of these neutrons are a function, in part, of the solid angle subtended by whatever is being irradiated, it is best to use as small a detector as possible. A new detector has been designed and one prototype constructed.

43241 (RAL–89-030) **Measurement and prediction of the drift-distance/drift-time relationship of a small jet chamber operated with carbon dioxide/isobutane.** Carter, J.R.; Elcombe, P.A.; Hill, J.C. and others. Rutherford Appleton Lab., Chilton (UK). May 1989. 32p. Order Number DE89635588/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
Submitted for publication to Nuclear Instruments and Methods in Physics Research.

As part of the preliminary studies for the vertex jet chamber of OPAL a small prototype chamber has been operated using carbon dioxide /isobutane and argon/ethane. A nitrogen laser has been used to produce an ionizing track in the chamber at a distance to the sense-wire plane that could be varied by means of a quartz pentaprism attached to a micrometer. This has enabled the drift-distance/drift-time relationship to be measured with an accuracy of 5-10μm. The drift-distance/drift-time relationship has also been predicted from calculations of the electric field configuration inside the chamber and of the electron drift-velocity as a function of electric field. Measurements and predictions agree to the level of $\sim$ 10μm, thus demonstrating the feasibility of drift-distance/drift-time predictions for the final vertex jet chamber of OPAL, for which detailed laser measurements will not be possible. Corrections to the drift-distance/drift-time relationship for small variations in pressure, temperature and gas composition have also been predicted and shown to be in agreement with experimental measurements. As an alternative to the separate measurement of pressure, temperature and gas composition, it has been demonstrated that a direct measurement of the drift-velocity at one point in the chamber enabled the corrections to the drift-distance/drift-time relationship over the entire chamber volume to be calculated to the $\sim$ 10μm level. (Author).

43242 (SLAC-PUB–5028) **The SLD [SLC Large Detector] calorimeter systems.** Benvenuti, A.C.; Piemontese, L.; Calcaterra, A.; De Sangro, R.; De Simone, P.; Peruzzi, I.; Piccolo, M.; Burrows, P.N.; Busza, W.; Cartwright, S.L. Stanford Linear Accelerator Center, Menlo Park, CA (USA); Massachusetts Inst. of Tech., Cambridge, MA (USA); Wisconsin Univ., Madison, WI (USA). Jul 1989. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515;AC02-76ER03069;AC02-76ER00881. (CONF-8905194–1: 4. Pisa meeting on advanced detectors: frontier detectors from frontier physics, 21-26 May 1989). Order Number DE89013986/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A brief description is given of the SLD calorimeter system, with emphasis on the iron calorimeter/muon identifier. Design choices and expected performance are summarized. 6 refs., 8 figs.

43243 (SLAC-PUB–5041) **Tracking with wire chambers at the SSC.** Hanson, G.G.; Gundy, M.C.; Palounek, A.P.T. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1989. 30p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515;AC03-76SF00098. (CONF-8905194–2: 4. Pisa meeting on advanced detectors: frontier detectors from frontier physics, La Biodola (Italy), 21-26 May 1989). Order Number DE89013990/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Limitations placed on wire chambers by radiation damage and rate requirements in the SSC environment are reviewed. Possible conceptual designs for wire chamber tacking systems that meet these requirements are discussed. Computer simulation studies of tracking in such systems are presented. Simulations of events from interesting physics at the SSC, including hits from minimum bias background events, are examined. Results of some preliminary pattern recognition studies are given. 13 refs., 11 fig., 1 tab.

43244 (UCRL–100106) **Multiple gauges for in situ measurements of pressure and particle velocity in condensed materials.** Urtiew, P.A.; Erickson, L.M. Lawrence Livermore National Lab., CA (USA). 14 Jul 1988. 17p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890739–3: 12. international colloquium on the dynamics of explosions and reactive systems, Ann Arbor, MI (USA), 23-28 Jul 1989). Order Number DE89016655/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In situ measurements of pressure and particle velocity have always been crucial in the development of theoretical models and formulation of equations of state for both inert and reactive materials. Formerly, measurements were made with separate gauge stations placed between layers of investigated material stacked in the direction of shock propagation. This arrangement not only generates a disturbance in the flow field but also causes interruption in the chemical reaction process being monitored. The introduction of multiple gauge packages placed on an inclined surface has eliminated most of the problems encountered with separate in line gauge stations. Such multiple gauges provide the capability of measuring changes in pressure and particle velocity at depth intervals much smaller than those between separate gauge stations. In addition each consecutive gauge element is not engulfed in the flow wake of the preceding one. The multiple element gauges described here are ideal for monitoring rapid changes in pressure and particle velocity in processes such as transition to detonation or phase

transformation. With this arrangement in a single experiment one can have as many as twelve signal traces from within a very thin depth in a sample. 20 refs., 9 figs.

43245 Advanced forward calorimetry for the SSC and TeVatron collider. DiBitonto, D. (Texas A and M Univ., College Station (USA)); Van Peteghem, P.M.; Geiger, R.L.; McIntyre, P.M.; Pang, Y.; Thane, J.M.; White, J.T.; Atac, M. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 279(1/2): 100-106 (1 Jul 1989). DOE Contract AS05-81ER40039. (CONF-8806235–: International conference on advanced technology and particle physics, 12-17 Jun 1988).

We describe a project to develop fast, radiation hardened forward calorimetry for the SSC and TeVatron collider. Detector technologies discussed are based on gas and warm liquid media. In particular, we present the design of an ultrasensitive hybrid charge preamplifier for liquid technology capable of operating at 0.1-1 GHz. The actual detector bandwidth will depend on the choice of detector media used and the maximum allowable operating high voltage. (orig.).

43246 Waveform digitizing at 500 MHz. Atiya, M. (Brookhaven National Lab., Upton, NY (USA). Physics Dept.); Ito, M.; Haggerty, J.; Ng, C.; Sippach, F.W. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 279(1/2): 180-185 (1 Jul 1989). DOE Contract AC02-76CH00016. (CONF-8806235–: International conference on advanced technology and particle physics, 12-17 Jun 1988).

Experiment E787 at Brookhaven National Laboratory is designed to study the decay $K^+ \rightarrow \pi^+ \nu\text{anti}\ \nu$ to a sensitivity of 2×10^{-10}. To achieve acceptable muon rejection it is necessary to couple traditional methods (range/energy/momentum correlation) with observation of the $\pi^+ \rightarrow \mu^+ \nu$ decay sequence in scintillator. We report on the design and construction of 200 channels of relatively low cost solid state waveform digitizers. The distinguishing features are: 8 bits dynamic range, 500 MHz sampling, zero suppression on the fly, deep memory (up to 0.5 ms), and fast readout time (100 μs for the entire system). We report on data obtained during the February-May 1988 run showing performance of the system for the observation of the above decay. (orig.).

43247 Fast neutron damage in silicon detectors. Kraner, H.W. (Brookhaven National Lab., Upton, NY (USA)); Li, Z.; Posnecker, K.U. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 279(1/2): 266-271 (1 Jul 1989). DOE Contract AC02-76CH00016. (CONF-8806235–: International conference on advanced technology and particle physics, 12-17 Jun 1988).

Radiation effects of fast neutrons have been measured in silicon detectors of varying resistivity irradiated to $\simeq10^{11}$ n/cm^2 over periods of weeks. The principal damage effect is increased leakage current due to generation of carriers from defect levels in the depletion region. Damage and leakage current constants have been established for detector resistivities between 10 and 27000 Ω cm and lie in the range of (0.7-2)x10^7 s/cm^2 (K) for PuBe neutrons. A slight increase in K was observed for higher resistivities which translates into somewhat improved radiation hardness. A fit of these data was attempted to a two-level recombination formulation of the damage constant. (orig.).

43248 The central tracking detectors for D0. Clark, A.R. (Lawrence Berkeley Lab., CA (USA)); Goozen, F.; Klopfenstein, C.; Kerth, L.T.; Loken, S.; Strovink, M.; Trippe, T.G.; Bantly, J.; Buchholz, D.; Claes, D. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 279(1/2): 243-248 (1 Jul 1989). DOE Contract AC03-76SF00098;AC02-80ER10699;AC02-76ER02289. (CONF-8806235–: International conference on advanced technology and particle physics, 12-17 Jun 1988).

Three types of drift chambers are being constructed for the Fermilab D0 experiment. The construction and readout of these chambers stress good spatial resolution, good two hit separation, and dE/dx measurement. A 106 MHz FADC system with hardware zero suppression is being constructed to read out this system. (orig.).

43249 The computer controlled VME high voltage system for the D-Zero detector. Droege, T.F. (Fermi National Accelerator Lab., Batavia, IL (USA)); Shea, M.F.; Goodwin, R.W.; Johnson, M.E.; Jones, A.A.; Roberts, K.; Wimpenny, S.J. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 279(1/2): 359-363 (1 Jul 1989). (CONF-8806235–: International conference on advanced technology and particle physics, 12-17 Jun 1988).

We have designed and prototyped a new VME based high voltage system for the D-Zero experiment at Fermilab. The power supply and control system are both new designs and combined have more flexibility and dynamic range than anything available on the commercial market. (orig.).

43250 D0 muon system with proportional drift tube chambers. Brown, C. (Fermi National Accelerator Lab., Batavia, IL (USA)); Eartly, D.; Green, D.; Haggerty, H.; Hansen, S.; Joestlein, H.; Malamud, E.; Martin, P.; Oshima, N.; Yamada, R. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 279(1/2): 331-338 (1 Jul 1989). (CONF-8806235–: International conference on advanced technology and particle physics, 12-17 Jun 1988).

The muon detection system for the Fermilab D0 detector is described. It has better muon detection performance than other existing hadron collider detectors, with respect to both hadron attenuation length and position resolution. In the large angle region there are three large magnetized toroids and a total of 10 planes of proportional drift tube chambers made of 10 cm wide cells. At both small angles there are magnetized toroids and 9 planes of proportional drift tubes made of 3 cm diameter stainless steel tubes. The 10 cm wide cell structure is made of specially designed aluminum extrusions, which make the assembly of a whole chamber easy. The chamber is provided with vernier pads so that the position of a charged particle can be simultaneously detected in both directions perpendicular and parallel to the sense wire. The system resolution goal along the wire is ±2.0 mm and perpendicular to the wire ±0.5 mm. (orig.).

43251 The mid-rapidity calorimeter for the relativistic heavy-ion experiment WA80 at CERN. Awes, T.C. (Oak Ridge National Lab., TN (USA)); Baktash, C.; Cumby, R.P.; Ferguson, R.L.; Gabriel, T.A.; Johnson, J.W.; Lee, I.Y.; Obenshain, F.E.; Plasil, F.; Young, G.R. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 279(3): 479-502 (15 Jul 1989). DOE Contract AC05-84OR21400;AC03-76SF00098.

A sampling calorimeter designed for use at mid-rapidity in the relativistic heavy-ion experiment WA80 at CERN is described. Calibration and performance results are presented. Over the energy range of 2 to 50 GeV, the response of the mid-rapidity calorimeter was linear, and its energy resolution σ/E was found to be given by $0.014+0.11/\sqrt{E}$ and $0.034+0.34/\sqrt{E}$ for electromagnetic and hadronic showers, respectively. Signal ratios of 1.2 and 1.4 were obtained for the e/h ratio of the lead-scintillator electromagnetic section and the iron-scintillator hadronic section, respectively. The calorimeter provided an accurate transverse energy trigger. The response and resolution for high-energy heavy ions were slightly better than anticipated on the basis of the low-energy calibrations. (orig.).

43252 A high precision peak sensing circuit for measuring the integral linearity of nuclear pulse amplifiers. Rogers, L.C. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 279(3): 573-578 (15 Jul 1989). DOE Contract AC02-76CH00016.

This paper describes a new instrument that very accurately transforms the peak height of repetitive waveforms into a dc voltage. Used in conjunction with a precision pulse generator, this instrument provides an improved method for establishing the integral linearity of pulse amplifiers. A measured overall accuracy of 0.005% for pulses with a nominal 1.0 μs peaking time has been achieved. This method is particularly useful with very fast amplifiers in the 5-100 ns range. The results of linearity measurements on several typical amplifiers are presented. (orig.).

43253 CCD and vidicon x-ray detectors: Theory and practice. Gruner, S. M. (Department of Physics, Princeton University, Princeton, New Jersey 08544 (US)). *Review of Scientific Instruments (USA)*, 60(7): 1545-1551 (Jul 1989).

Because of their ability to handle the highest count rates expected at synchrotron sources, CCD and vidicon-based two-dimensional x-ray detectors are being configured into many beam lines. Although the CCD or vidicon sensing element determines the ultimate capabilities of these detectors, the practical usage of these detectors is also constrained by the specific configuration of the phosphor, intensifier, optical coupling, and readout modes which are used. Results are presented on the design of CCD and vidicon-based detectors for a variety of x-ray imaging problems. The versatility and limitations of a variety of detector configurations are discussed.

43254 Experimental techniques for the study of nuclear Bragg scattering in systems containing ^{57}Fe. Siddons, D. P. (Brookhaven National Laboratory, Upton, New York 11973 (US)); Hastings, J. B.; Faigel, G.; Grover, J. R.; Haustein, P. E.; Berman, L. E. *Review of Scientific Instruments (USA)*, 60(7): 1649-1654 (Jul 1989).

Resonant filtration of synchrotron radiation has been proposed as a method of obtaining x rays with extremely narrow bandwidths (or very long coherence lengths). Resonant scattering of x rays and neutrons is of general interest, and displays several phenomena, which require novel instrumentation in order to be properly observed. We describe here some of the techniques which we have developed for the specific purpose of studying dynamical diffraction by the Mössbauer resonance in ^{57}Fe.

43255 Current-to-frequency converter for electron multipliers. Carr, R. (Stanford Synchrotron Radiation Laboratory, P.O. Box 4349, bin 69, Stanford, California 94309 (US)); Yang, J. *Review of Scientific Instruments (USA)*, 60(7): 2321-2323 (Jul 1989). DOE Contract AC03-82ER13000.

We have developed a current-to-frequency converter which is designed to be used with electron multipliers whose anodes are raised to high voltages. It has three sensitivity scales: 10 fC/Hz, 100 fC/Hz, and 1 pC/Hz, with 6.7 decades of dynamic range in each scale. We show that this technique has the high signal-to-noise ratio required for use with electron detectors such as channel plate multipliers and channel electron multipliers.

4403 Miscellaneous Instruments

Refer also to citation(s) 41507, 41534, 41612, 41771, 41892, 42218, 42350, 42379, 42492, 42585, 42609, 42648, 42649, 42675, 42742, 43021, 43039, 43305, 43306, 43690

43256 (AD-A–205688/5/XAB) **Use of a spectrally segmented photodiode-array spectrometer for inductively coupled plasma atomic-emission spectroscopy. Technical report.** Furuta, N.; Brushwyler, K.R.; Hieftje, G.M. Indiana Univ., Bloomington, IN (USA). Dept. of Chemistry. 10 Feb 1989. 29p. Available from NTIS, PC A03/MF A01.

The utility of a spectrally segmented photodiode array spectrometer was examined by using inductively coupled plasma atomic emission spectrometry (ICP-AES). The spectrometer used in this study is capable of high resolution (reciprocal linear dispersion of approximately 0.08 nm/mm at 300 nm) over a wide spectral range (190-145nm). The effect of using spectral-peak areas instead of peak heights as a signal definition was determined by using the emission signals from 10 molybdenum lines obtained at various photodiode-array integration periods. In addition, a signal definition involving a summation over a range of 5 pixels offered the best signal-to-noise ratio when the noise was defined as the standard deviation of the residual values from the line fit to the sideband background level. A detection limit of 6 ng/ml was determined in this way for molybdenum. The multichannel capability of the spectrometer was found to permit continuous background correction, thereby reducing errors caused by low-frequency noise or plasma drift. Detector linearity was found to extend over three orders of magnitude with a single integration period.

43257 (AD-A–205985/5/XAB) **Quantum theory of the nonlinear interferometer.** Shirasaki, M.; Haus, H.A.; Wong, D.L. Massachusetts Inst. of Tech., Cambridge, MA (USA). Research Lab. of Electronics. Jan 1989. 8p. Available from NTIS, PC A02/MF A01.

Pub. in Jnl. of the Optical Society of America B, Vol. 6, No. 1, 82-88(Jan 1989).

A full quantum theory of the Mach-Zehnder interferometer with nonlinear Kerr media in both arms is presented. The nonlinear operator equations can be integrated, and the result can be normal-ordered. This permits the evaluation of the factorial moments of the photon number to all orders of the nonlinearity. Various excitations and phase biases are studied. The degree of squeezing by the interferometer is determined.

43258 (AECL–9522) **Radiotracer techniques for measuring fluid flow and calibrating flow meters.** Cooper, E.L. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Aug 1987. 25p. Order Number DE89635596/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Radiotracer techniques can be used to measure accurately both gas and liquid flow rates under operating conditions in a wide range of flow systems. They are ideally suited for calibrating flow meters as well as for measuring unmetered flows in industrial plants. Applications of these techniques range from measuring the flows of fuels and process fluids for energy and mass balance studies to measuring the flows of liquid and airborne effluents for pollution control. This report describes the various radiotracer techniques which can be used to measure fluid flows. The range of application and inherent accuracy of each technique is discussed.

43259 (AOSTRA–8808, pp. 12) **I R analyzer for stability measurements of residual oils.** Lambert, D.C. (BP France, Lavera, France); Holder, K.A. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, 7-12 Aug 1988; CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The thermal treatment of heavy oils and residues results in a reduction in the stability of the products. In visbreaking, for example, all feedstocks have a maximum conversion limit which, if exceeded, would lead to the production of an unstable oil product. A solvent precipitability model has been devised to characterize those changes that take place during processing, which can lead to asphaltene deposition. The stability of the oil is determined by two parameters. XA is a measure of the precipitability of the least soluble asphaltenes. XS measures the ability of the oil to maintain its asphaltenes in solution. A third parameter, the solvent power (SP) is derived from XA and XS. A new, automated apparatus has been developed to determine the stability of petroleum products according to this principle. The onset of flocculation is measured with a turbidimetric method, using infrared radiation and optic fibres. The apparatus can determine the flocculation parameters in less than 30 minutes and offers improved repeatability. It can be used to assess a wide range of materials, including crude oils, atmospheric and vacuum residues, fuels oils, and bitumens. It has been used successfully in refinery applications, including visbreaking, and as a research tool for residual oil upgrading. A version of this apparatus for on-line analysis is under development. 6 refs., 8 figs.

43260 (CONF-890462–1) **High-resolution imaging of semiconductor interfaces by Z-contrast STEM.** Pennycook, S.J.; Jesson, D.E.; Chisholm, M.F. Oak Ridge National Lab., TN (USA). 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 6. Oxford conference on microscopy of semiconducting materials; Oxford (UK); 10-13 Apr 1989. Order Number DE89015915/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A new technique for high-resolution electron microscopy is described using a high-angle annular detector in a STEM. The use of highly localized electron scattering gives the images strong chemical sensitivity and many of the characteristics associated with incoherent imaging; there are no contrast reversals with defocus or sample thickness, no Fresnel fringe effects at interfaces, no lateral

spreading of lattice fringes, and no contrast from within an amorphous phase. Column by column compositional sensitivity is achieved, even at interfaces, and rigid shifts are independent of thickness and defocus. 25 refs., 5 figs.

43261 (CONF-8611137–5) **A miniature fiber-optic probe for particle sizing.** Paul, P.H.; Kychakoff, G. Stanford Univ., CA (USA). Dept. of Mechanical Engineering. [1986]. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract FG03-85ER13393. From International congress on applications of lasers and electro optics; 1 Nov 1986. Order Number DE89015319/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

PARTICLE SIZE/measuring methods; FIBER OPTICS; MEASURING INSTRUMENTS; HELIUM-NEON LASERS; CALIBRATION; ELECTRO-OPTICAL EFFECTS; PHOTOMULTIPLIERS; ARGON IONS

43262 (CPS–8702, pp. 351-354) **Compound specific detectors for field information.** Overton, E.B. (Louisiana State Univ., Baton Rouge, LA, USA); Kummerlowe, D. Environnement Canada, Ottawa, ON (Canada). Conservation et Protection. 1987. (CONF-870295–: Technical seminar on chemical spills, Toronto (Canada), 9-12 Feb 1987; MICROLOG–87-01873). In *Proceedings [of the] 4th technical seminar on chemical spills.* Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada.

This paper describes a project that is developing instrumentation that can be used in field situations to identify and quantitate volatile toxic chemicals at trace levels (compound-specific analyses). Its goals include the development of portable analytical instrumentation that can produce laboratory quality analyses of volatile toxic chemicals with sensitivities in the low ppM and with short analytical response times. Further, the analytical devices must have the capability to transmit chemical data from remote field locations to a central laboratory facility for interpretation by a trained chemist, if needed. Methods employed in the instrument development project include modification of off-the-shelf analytical equipment, originally designed for in-lab applications, to meet the needs of rugged, field deployable instrumentation. Since no single analytical device is universally applicable or capable of providing compound-specific field analyses for the wide variety of toxic chemicals in common use, five different types of chemical instruments were chosen for this development project. These include: a small portable microchip high resolution gas chromatograph bench-top mass spectrometer, a Fourier Transform infrared spectrometer, a piezoelectric quartz microbalance, and small portable gas chromatographs with electron capture and photoionization detectors.

43263 (EGG–10617-5019) **Streak camera system for prompt display of laser pulses.** Baumgart, J.S.; Justice, R.; Bender, S. EG and G Energy Measurements, Inc., Los Alamos, NM (USA). Los Alamos Operations. [1989]. 23p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-88NV10617;W-7405-ENG-36. Order Number DE89015305/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

The streak camera is a useful tool for doing imaging experiments. Its high bandwidth and large information carrying capacity provide great flexibility in data recording. This paper describes a streak system used to make two-dimensional measurements on a pulsed laser system. The streak system measures beam position, full width, relative intensity, and shape on multiple pulses in a single sweep. These measurements are analyzed in real time and displayed for user feedback. 18 figs.

43264 (ENEA-RT-TIB–88-25) **Optical scanners: design and performance of the ENEA (Italy) digital imagery system.** Della Rocca, A.B.; Ferriani, S. ENEA, Casaccia (Italy). Dipt. Tecnologie Intersettorialli di Base; ENEA, Casaccia (Italy). Dipt. Reattori Veloci. Dec 1988. 54p. (In Italian). Order Number DE89761943/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The EDI (ENEA Digital Imagery) image processing system, operating at the ENEA Casaccia (Italy) research centre, has an optical scanner for digitizing analogic images. Obviously, the A/D conversion process degrades the content of the images and restoring the digital images obtained becomes a crucial point. For this aim, it is necessary to find out the way the scanner actually works in order to know and quantify distortion sources. This report describes criteria and methods followed for measuring I/O parameters and evaluating performances of the EDI optical scanner.

43265 (INIS-mf–11474) **Safety and regulatory aspects in the utilization of radiation and radioactive material.** Abdul Majid Hasan. Atomic Energy Licensing Board, Kuala Lumpur (Malaysia). 1987. 8p. (CONF-8711314–: Seminar on the application of nuclear techniques in industry, 17 Nov 1987). Order Number DE89635598/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI.

The main objective of the Atomic Energy Licensing Act, 1984 is to regulate and control all activities dealing with atomic energy. For this purpose the Atomic Energy Licensing Board, (AELB) was established and responsibilities for authorizing, enforcing and establishing guidelines of activities to ensure safety for radiation workers, members of public and environment. To achieve these functions AELB will assess the proposed activities, if safe licence will be issued within its conditions. To ensure the licensee comply with the conditions of licence, a team of inspectorate will inspect its operation. AELB also provides guidelines and procedures of radiation protection to the licensee and anyone who intends to involve in utilization of atomic energy. (author).

43266 (INIS-SU–100, pp. 41-45) **Electrostatic energy analyzers on the basis of the mirrors with two-plate electrodes.** Kel'man, V.M. (AN Kazakhskoj SSR, Alma-Ata (USSR). Inst. Yadernoj Fiziki); Karetskaya, S.P.; Bejzina, L.G.; Sajchenko, N.Yu. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The corpuscular-optical properties of energy analyzers of the new type are discussed. It is shown that these analyzers of small sizes have high energy dispersion, focuse a charged particle beam in two mutually orthogonal directions without second order spherical aberrations. They are simple in design and their properties can be easily controlled using potentials on electrodes. They can be used to analyze low energy radiations. 6 refs.; 3 figs.

43267 (KIYI–88-21) **Grafic subsystem on SM EVM base.** Gavrilyuk, V.I.; Lyubarskij, V.A.; Ostapenko, B.V. AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. 27p. (In Russian). Order Number DE89635599/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A subsystem realized on base of PDP-11 computer with raster and vector graphic devices: colour symbolic-graphic displays, screen printing and plotters is described. The software is presented by device-dependent low-level procedures of adaptive graphic packet IBM PC in PASKAL language realizing the main concepts of GKS standard for personal and technicak computers. Possibilities of graphic terminals and IBM PC store are completely realized or emulated. PASKAL language permits to use the packet in different executive systems, in RSX-11 and RT-11 in particular. 4 refs.; 4 tabs.

43268 (LA-UR–89-2547) **High speed single transient microwave spectrum analyzer.** Stokes, J.; Ogle, J.; Looney, L.; Gallegos, C.; Anaya, R.; Lilijestrand, R. Los Alamos National Lab., NM (USA). [1989]. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890836–4: 33. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering, 6-11 Aug 1989). Order Number DE89015286/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Recent experiments have required the measurement of short pulse high bandwidth microwave spectra. To meet this need we built a GHz-bandwidth acousto-optic spectrum analyzer. The hardware includes a HeNe laser, collimating optics, Brag cell, steak camera, microchannel plate intensifier and film cassette. The frequency range measured was 350–2000 MHz with a dynamic range

greater than 20 dB. Pulse widths from 10 ns were measured with this system. 4 figs.

43269 (LBL–26882) **Design of grazing incidence monochromators involving unconventional gratings.** McKinney, W.R.; Palmer, C. Lawrence Berkeley Lab., CA (USA). Jan 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890142–5: Symposium on lasers and optics, 15-20 Jan 1989). Order Number DE89016341/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We review the basic aspects of second order focusing of straight and parallel grooved varied line space gratings in both converging and collimated light in a more explicit and detailed manner that we have found in the literature. The effects of the VLS correction to the location of the focal curve for grazing incidence geometries are found to be very significant. 6 refs., 6 figs.

43270 (MLM–3602-OP) **A digital imaging for quantitatively measuring tritium concentration in metallographic samples.** Ransick, M.H.; Downs, G.L. EG and G Mound Applied Technologies, Miamisburg, OH (USA). 1989. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-88DP43495. (CONF-8907116–3: 22. annual international Metallographic Society meeting, 23 Jul 1989). Order Number DE89015382/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The development of the Video Intensified Microscope coupled with digital image processing techniques offers a new way to quantitatively measure tritium concentration in metallographic mounts. Beta particles from the decay of tritium strike a scintillation film placed on the sample causing photons to be generated. The photon signal emitted from the sample is digitized and stored in an array of pixels within a digitizing board. The time required for the acquisition of these images is on the order of minutes instead of the hours or days normally required for traditional photographic autoradiography techniques. By utilizing the techniques of digital image processing and analysis, tritium concentration can be statistically analyzed. Depth profiling of tritium into a material and two dimensional concentration gradients can be plotted and analyzed. These images are also saved to optical disks for later recall and comparison and archiving. 5 figs.

43271 (OH/RD–88-64-K) **A review of aluminum oxide sensors.** Singh, V.P. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 27p. (MICROLOG–89-02564). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CAN-MET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A literature review was carried out on the performance of aluminum oxide sensors for water vapor pressure (dew point) determinations. Unless adequately aged, significant drifts occur in the sensor output, the drift rate being aggravated by operation at high dew point. For Panametrics sensors, the response time when a dew point decrease occurs is significantly longer than the manufacturer's claim. Recommendations are made for storing the sensor and determining the effect of the sensor filter on the response time. 43 refs., 2 figs.

43272 (PTB-W–37, pp. 5-29) **Gas calorimeter for measuring the calorific value.** Assenmacher, H. (Ruhrgas A.G., Essen (Germany, F.R.)); Herbst, G. Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Waerme. Jun 1988. (In German). (CONF-8712127–: 67. PTB-seminar on state and development of gas calorimetry and charging for heating gas, Braunschweig (Germany, F.R.), 10-11 Dec 1987). In *State and development of gas calorimetry and charging for heating gas. Proceedings.* Order Number DE89795859/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01.

In 1969, the West German Parliament passed a law on measurement and calibration (called the Calibration Law for short), which came into force on 01.07.1970. In paragraph I, this law states that measuring equipment for the direct or indirect determination of thermal or electrical energy or power must be calibrated (certified) if they are used in business. Calibration presupposes that the equipment is capable of being calibrated and it must comply with the approval requirements of the West German Physical/Technical Institute (PTB). (orig./HW).

43273 (PTB-W–37, pp. 31-38) **Calorimetric calibration gases.** Klinge, H. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Waerme. Jun 1988. (In German). (CONF-8712127–: 67. PTB-seminar on state and development of gas calorimetry and charging for heating gas, Braunschweig (Germany, F.R.), 10-11 Dec 1987). In *State and development of gas calorimetry and charging for heating gas. Proceedings.* Order Number DE89795859/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01.

Charging for natural gas is not only done according to the volume of gas used, but also according to its calorific value (thermal gas charge), which is determined by automatic gas calorimeters. There is a description of the absolute measurements of calorific value with indirect determination of the quantity of combustion gas. Data are given on the flame calorimeter used, the reaction vessel and combustion gas cylinder and on the calorific values of hydrogen and methane (tables, data from the literature, unit conversion factors). The mixture of methane/nitrogen and the mixture of methane/ethane could be recognised as calibration gases of the 2nd order for the natural gas area due to the good agreement of a ring comparison of several institutes. Only hydrogen could be considered as the calibration gas (pure gas) for the grid gas area. As its calorific value is too far from that of grid gas, a calibration mixture of hydrogen/methane/nitrogen was used. (HWJ).

43274 (PTB-W–37, pp. 39-46) **Approval test of gas calorimeters.** Niedung, W. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Waerme. Jun 1988. (In German). (CONF-8712127–: 67. PTB-seminar on state and development of gas calorimetry and charging for heating gas, Braunschweig (Germany, F.R.), 10-11 Dec 1987). In *State and development of gas calorimetry and charging for heating gas. Proceedings.* Order Number DE89795859/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01.

Due to technical progress and the inclusion of new types of measuring equipment, the extent of the regulations for calibration have increased to such an extent that the Calibration Order is at present being revised. However, there is no change for the approval test of automatic gas calorimeters due to the new edition of the building regulations (PTB requirements) contained in the Calibration Order. There are descriptions of the basic technical requirements such as burning samples of gas in the intended range of calorific values, linearity of heat exchangers, and positioning of the outlet thermometer. Investigations of the properties of the 'measuring device' (gas meter, heat medium, air meter, water meter, pair of measuring pipes for gas and water, converter) and the causes of varying results are then explained. Finally, data are given on tests of the parts of gas calorimeters with electronic components regarding 'electromagnetic compatibility'. The sample of a test report is shown. (HWJ).

43275 (PTB-W–37, pp. 47-63) **On determining the calorific value of gases by means of process gas chromotography.** Below, L. (Ruhrgas A.G., Essen (Germany, F.R.)); Herbst, G. Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Waerme. Jun 1988. (In German). (CONF-8712127–: 67. PTB-seminar on state and development of gas calorimetry and charging for heating gas, Braunschweig (Germany, F.R.), 10-11 Dec 1987). In *State and development of gas calorimetry and charging for heating gas. Proceedings.* Order Number DE89795859/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01.

While only automatic gas calorimeters are authorized for calibration in the Federal Republic of Germany for determining the calorific value of gases, in other countries the calorific value is calculated from the gas chromatography analysis of certain gas compositions. There is a report on the present technical state of process gas chromatography (PGC) and there is a comparison with calorimetry. The PGC requirements (18 points) are first stated. Automatic PGC equipment with control, evaluation, display and recording unit and a sampling system complying with these requirements was tested for

determining the calorific value. Data are given on the repeatability of the analysis of rare gases and PGC calibration (calibration gas, calibration cycle) and on the comparison of PGC and calorimeter. It was found that the calculation of the calorific value from gas analysis constitutes a useful alternative to calorimetric determination of the calorific value. (HWJ).

43276 (PTB-W–37, pp. 79-88) **Calibration gases for use in gas chromotographs as calorific value measurement equipment capable of calibration.** Karl, W. (Bundesanstalt fuer Materialforschung und -pruefung, Berlin (Germany, F.R.)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Waerme. Jun 1988. (In German). (CONF-8712127–: 67. PTB-seminar on state and development of gas calorimetry and charging for heating gas, Braunschweig (Germany, F.R.), 10-11 Dec 1987). In *State and development of gas calorimetry and charging for heating gas. Proceedings.* Order Number DE89795859/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01.

Similarities and differences between gas mixtures are shown, which are used as test gases or calibration gases for process gas chromatographs or measurement equipment liable for calibration. The requirements made of these calibration gases are made clear in 5 detailed points, the careful manufacture of gas mixtures is dealt with and the necessity for certification of the calibration gases is explained. One is also concerned with the manufacture of the test gases required for certification (statement of components of the mixture) and with carrying out the certification analysis (multi-part analysis with the carrier gases nitrogen and helium). (HWJ).

43277 (PTB-W–37, pp. 89-98) **Long-term sampling by means of an electronic sampler.** Homann, K. (Vereinigte Elektrizitaetswerke Westfalen AG (VEW), Bochum (Germany, F.R.)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Waerme. Jun 1988. (In German). (CONF-8712127–: 67. PTB-seminar on state and development of gas calorimetry and charging for heating gas, Braunschweig (Germany, F.R.), 10-11 Dec 1987). In *State and development of gas calorimetry and charging for heating gas. Proceedings.* Order Number DE89795859/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01.

In a 420 km long high pressure gas transport ring (H and L gas system), as gas quality measurement system was fitted, consisting of 8 gas samplers distributed over the whole network and a central gas chromatography station. The gas samples are taken automatically and filled into pressure vessels. There are reports on the method of operation of the sampler system (pneumatic circuit diagram) supported by a microprocessor, on the design (gas pressure controller, measurement system, sample bottle, solenoid valve control) and on the uncertainty of measurement of the calorific value for these gas samples (pressure and temperature effects, number of samples, scanning time, faults with interruption, spline interpolation, diagrams). (HWJ).

43278 (PTB-W–37, pp. 105-111) **Experience with approval test of gas chromatographs as calorific value measurement equipment.** Niedung, W. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Waerme. Jun 1988. (In German). (CONF-8712127–: 67. PTB-seminar on state and development of gas calorimetry and charging for heating gas, Braunschweig (Germany, F.R.), 10-11 Dec 1987). In *State and development of gas calorimetry and charging for heating gas. Proceedings.* Order Number DE89795859/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01.

A survey is given on some special requirements for gas chromatographs as measurement equipment capable of being calibrated for the indirect determination of gas calorific values and their application in an approval test. Internal calibration gases (automatic adjustment of the gas chromatograph), carrier gases (purity, helium, nitrogen) and some examples from approval tests (permitted and prohibited ranges and functioning after calibration) are dealt with. These include inspection of the separation behaviour of the column and the detector function from the chromatogram (line recorder), the checking of interface free of feedback (printer, additional devices), the inspection of internal and external sealing (gas circuit, valves), calibration technique testing (suitable calibration gases, duration of validity of calibration) and permanent experiments (16 component calibration mixture). (HWJ).

43279 (SAND–88-2911C) **A comparison of real-time optical correlators for pattern recognition.** Stalker, K.T.; Molley, P.A.; Hansche, B.D. Sandia National Labs., Albuquerque, NM (USA). 1989. 15p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8904242–3: International congress on optical science and engineering, 24-28 Apr 1989). Order Number DE89016416/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Two types of optical correlators have been built to investigate real-time pattern recognition. The first employs one-dimensional devices to perform the two dimensional correlation in real time. This architecture uses an array of light emitting diodes (LED's) to input an electronically stored reference image into the processor in parallel. The input scene data is introduced into the processor one line at a time using an acousto-optic device (AOD). Multichannel time integrating correlations are performed in the row direction using the AOD and in the column direction using a charge coupled device (CCD) operating in the time delay and integrate mode. a processor has been built using this technology which correlates a 64 x 44 pixel binary reference image with a 256 x 232 input scene at video rates. The second correlator is a space integrating Fourier transform based correlator. A magneto optic-device (MOD) is used at the Fourier transform plane to rapidly change filter functions. The binary nature of the MOD device necessitates using either a binary phase or binary amplitude representation of the desired complex filter function. For this reason, several types of Binary Phase-Only Filter (BPOF) representations have been analyzed and experimentally investigated. Experimental correlation results have been obtained using both the Hartley BPOF and a newly developed class of complex binary filters, called Quad-Phase-Only Filters (QPOF). The performance of the two systems will be compared on the basis of processing speed, space bandwidth product, processor size and light efficiency. The inherent differences between incoherent and coherent processing and their implications for filter design will also be discussed. Finally, estimates of future performance will be presented. 10 refs., 8 figs., 2 tabs.

43280 (UCRL–52000-88-10, pp. 37-43) **Computational x-ray holography.** Yorkey, T.J.; Brase, J.M.; Clark, G.A. Lawrence Livermore National Lab., CA (USA). Oct 1988. In *Energy and technology review.* Order Number DE89005308/JAW. Available from NTIS, PC A03/MF A01.

Visible-light experiments and numerically simulated holograms are being used to test ideas about the performance of an x-ray microscope suitable for biological research. For simple Gabor holography, the plane-to-plane reconstruction via the Fresnel integral contains unwanted virtual-image information. The authors computationally reduce or eliminate the virtual image by taking advantage of other knowledge about the object of interest. To obtain information about depth, the Born approximation is used, which assumes a small amount of scattering, and filtered backpropagation for the reconstruction. The studies show poor longitudinal resolution with a single view and great improvement with multiview holography. These investigations begin to define expectations for the performance of an x-ray microscope suitable to examine objects of the size of cells and cell structures of living specimens. 5 references, 4 figures.

43281 **Temporal and spectral self-shifts of dark optical solitons.** Weiner, A. M. (Bellcore, 331 Newman Springs Road, Red Bank, New Jersey 07701-7040 (US)); Thurston, R. N.; Tomlinson, W. J.; Heritage, J. P.; Leaird, D. E.; Kirschner, E.; Hawkins, R. J. *Optics Letters (USA),* 14(16): 868-870 (15 Aug 1989). DOE Contract W-7405-ENG-48.

We report the discovery of temporal and spectral self-shifts of dark optical solitons propagating in single-mode fibers. These shifts become increasingly pronounced as the intensity and the fiber length are increased. We show that our data are in quantitative agreement with numerical solutions to a modified nonlinear Schrödinger equation that includes the Raman contribution to the nonlinear refractive index.

43282 Compact vacuum ultraviolet source for photoelectron spectroscopy. Tonkyn, R. G. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973 (US)); White, M. G. *Review of Scientific Instruments (USA),* 60(7): 1245-1251 (Jul 1989). DOE Contract AC02-76CH00016.

A simple source chamber is described which enables the introduction of laser-generated, vacuum ultraviolet (VUV) radiation below 102 nm into most existing photoelectron and photoion spectrometers. A long capillary light guide provides a conductance barrier between the VUV source and experimental chambers, and also provides a small, well-collimated VUV beam at the interaction region. A platinum photodiode is found to provide a useful measure of the VUV intensity with minimal interference from the unconverted UV light. The performance and capabilities of the source are demonstrated by several applications using photoelectron spectroscopy.

43283 rf-induction plasma apparatus for generating submicron particles of metals. Barmore, W. L. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550 (US)); Hrubesh, L. W.; Keene, L. E.; Raymond, E. L. *Review of Scientific Instruments (USA),* 60(7): 1328-1333 (Jul 1989). DOE Contract W-7405-ENG-48.

A unique apparatus is described for generating submicron particles of metals over a narrow-size distribution range. Coarse particles of the metal were injected into the tail flame of an argon rf-induction plasma torch, where they were vaporized. The vapor was gas quenched, producing a metallic smoke of fine spheroidal particles. The system collection units separated the fine particles ($\sim$0.3-μm diameter) from the heavier particles ($\geq$1-μm diameter) while the material was finely dispersed and moving in the gas stream.

43284 Measurement of the Hall coefficient using van der Pauw method without magnetic field reversal. Levy, M. (Department of Physics, City College of the City University of New York, New York, New York 10031 (US)); Sarachik, M. P. *Review of Scientific Instruments (USA),* 60(7): 1342-1343 (Jul 1989).

The van der Pauw geometry has been widely used for the measurement of resistivities and Hall coefficients. Although the measurement of a Hall coefficient requires a finite magnetic field, it should be noted that van der Pauw's expression is valid only in the limit of zero field; in addition to the Hall contribution, measurements in a finite magnetic field generally include a term associated with field-induced changes in the longitudinal resistivity. Although a simple solution to this problem entails taking the difference between readings in opposite field directions, there are circumstances where this may be impractical. In this note we present a straightforward extension of the van der Pauw calculation which allows a determination of the Hall coefficient from quantities measured in one field direction only.

43285 Ultrasoft (C,N,O) x-ray fluorescence detection: Proportional counters, focusing multilayer mirrors, and scattered light systematics. Fischer, D. A. (Exxon PRT, Brookhaven National Laboratory, Upton, New York 11973 (US)); Colbert, J.; Gland, J. L. *Review of Scientific Instruments (USA),* 60(7): 1596-1602 (Jul 1989).

Ultrasoft x-ray detection is discussed as applied to the fluorescence yield near edge spectroscopy (FYNES) technique. We describe a progression of improved ultra-high vacuum compatible soft x-ray proportional counters for FYNES measurements. The importance of energy dispersive detection is discussed and examples shown. Scattered light background problems are quantified and compared for several real samples. Finally, focusing multilayer mirror collection is introduced for reducing scattered light background and improved elemental differentiation in the fluorescence signal.

43286 Operation of a normal-incidence transmission grating monochromator at ALLADIN. Tatchyn, R. (Stanford Synchrotron Radiation Laboratory, Stanford University, Stanford, California 94305 and Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403 (US)); Kallne, E.; Toor, A.; Cremer, T.; Csonka, P. *Review of Scientific Instruments (USA),* 60(7): 1579-1587 (Jul 1989). DOE Contract FG06-85ER13309;AC03-82ER13000.

A transmission grating (TrG) monochromator has been constructed and operated on the ALLADIN storage ring in Wisconsin in March–June of 1987. The x-ray source was a recently installed 30-period permanent magnet (PM) undulator with a 6.1-cm period. The monochromator configuration employed a single-bent focusing mirror between the source and the exit slit, with a gold transmission grating located between the mirror and the exit slit. The effective entrance slit was the circulating electron beam inside the ring. In this article, the performance of the monochromator in terms of its power loading capability is described.

43287 Combined microstructure x-ray optics. Barbee, T. W., Jr. (Lawrence Livermore National Laboratory, Livermore, California 94550 (US)). *Review of Scientific Instruments (USA),* 60(7): 1588-1595 (Jul 1989). DOE Contract W-7405-ENG-48.

Multilayers are man-made microstructures which *vary* n *depth* and are now of sufficient quality to be used as x-ray, soft x-ray, and extreme ultraviolet optics. Gratings are man-made *in-plane* microstructures which have been used as optic elements for most of this century. Joining of these two optical microstructures to form combined microstructure optical elements has the potential for greatly enhancing both the throughput and the resolution attainable in these spectral ranges. The characteristics of these new optic elements will be presented and compared to the experiment with emphasis on the unique properties of these combined microstructures. The results reported are general in nature and not limited to the soft x-ray or extreme ultraviolet spectral domains and also apply to neutrons.

43288 The superconducting x-ray lithography source program at Brookhaven. Williams, G. P. (National Synchrotron Light Source, Brookhaven National Laboratory, Upton, New York 11973 (US)); Heese, R. N.; Vignola, G.; Murphy, J. B.; Godel, J. B.; Hsieh, H.; Galayda, J.; Seifert, A.; Knotek, M. L. *Review of Scientific Instruments (USA),* 60(7): 1628-1629 (Jul 1989). DOE Contract AC02-76CH00016.

A compact electron storage ring with superconducting dipole magnets, is being developed at the National Synchrotron Light Source at Brookhaven. The parameters of the source have been optimized for its future use as an x-ray source for lithography. This first ring is a prototype which will be used to study the operating characteristics of machines of this type with particular attention being paid to low-energy injection and long beam lifetime.

43289 Performance of a high-energy-resolution, tender x-ray synchrotron radiation beamline. Cowan, P. L. (National Institute of Standards & Technology, Quantum Metrology Division, Gaithersburg, Maryland 20899 (US)); Brennan, S.; Jach, T.; Lindle, D. W.; Karlin, B. A. *Review of Scientific Instruments (USA),* 60(7): 1603-1607 (Jul 1989). DOE Contract AC02-76CH00016.

Beamline X-24A at the National Synchrotron Light Source was designed for optimal performance in the x-ray spectral region 500–5000 eV. This choice of energy range placed a number of constraints on the beamline design, requiring a crystal monochromator in a windowless UHV environment. Although this increased the complexity of the design, there were compelling scientific reasons for our desire to work in this range. In addition to tunability over the selected energy range, a primary goal was to obtain the highest possible energy resolution in the primary beam. We have achieved incident energy resolution significantly better than the typical core-level lifetime broadening for this energy range. This has permitted studies of processes that are not broadened by lifetimes, such as resonant scattering and back-reflection x-ray standing-wave effects. In addition to high resolution, it was designed to collect and focus as much flux as possible from the bending magnet source.

43290 Polarization analysis of magnetic x-ray scattering. Gibbs, D. (Brookhaven National Laboratory, Upton, New York 11973 (US)); Blume, M.; Harshman, D. R.; McWhan, D. B. *Review of Scientific Instruments (USA),* 60(7): 1655-1660 (Jul 1989). DOE Contract AC02-76CH00016.

In this paper we discuss polarization analysis in x-ray magnetic scattering experiments. The cross section for x-ray scattering is calculated, including magnetic terms, and three examples of magnetic structures are considered. It is shown that the contributions of the orbital- and spin-magnetization densities may be identified by analyzing the polarization of the scattered beam. We describe an

instrument for performing linear polarization analysis in x-ray scattering experiments, and summarize its application in recent studies of holmium.

43291 Coherence saturation for energetic photons (abstract). Csonka, P. L. (Institute of Theoretical Sciences, University of Oregon, Eugene, Oregon 97403-5203 (US)). *Review of Scientific Instruments (USA),* 60(7): 1992-1992 (Jul 1989).

There are two well-known methods to generate coherent x-ray photons: bound state x-ray lasers (BXL) and free electron x-ray lasers (FEXL). Both rely on induced photon emission. Because of the short lifetime of inverted states and high required energy densities for BXLs on the one hand, and strict tolerance specifications for FEXLs on the other, serious technological obstacles have yet to be overcome before a working device will be available for research purposes, particularly in the hard x-ray range. Coherence saturation is proposed here as an alternative method to generate coherent energetic photon beams. It does not make use of stimulated emission, therefore, it is not subject to the same technological and cost restrictions which have so far limited the effectiveness of BXLs and FEXLs in the short wavelength range. In fact, the method does not affect the process of photon emission at all: instead it rearranges the photon after they have been emitted, to achieve an increase in (transverse) coherence. The rearrangement is to be accomplished by dynamical optical means, i.e., by a collection of optical elements at least one of which is nonstationary. The speeds required are well within the range of present day technology. The method was devised primarily to facilitate certain interference experiments (e.g., holography) in the x-ray range. Correspondingly, its aim is to increase (first-order) transverse coherence. The special case will be discussed when only one optical element is nonstationary, and that is a rotating mirror. The transversely coherent intensity, $I_\perp$, is defined as the number of photons crossing the (transverse) coherence area per unit time. Denoting by I the total photon intensity, define the (degree of) transverse coherence as $C_\perp = I_\perp / I$.

43292 Equitemporal optics: a method to generate subpicosecond x-ray pulses (abstract). Csonka, P. L. (Institute for Theoretical Sciences, University of Oregon, Eugene, Oregon 97403-5203 (US)). *Review of Scientific Instruments (USA),* 60(7): 1993-1993 (Jul 1989).

Certain classes of experiments would benefit from the availability of x-ray pulses of shorter time duration than what can be achieved today. These include accurate measurements of frequency and those of time resolution. One way to generate short x-ray pulses, is to utilize only part of an originally longer train of photons, and discard the rest. This approach is of little help if the phenomenon under study (such as synchrotron radiation pumped x-ray lasers) requires not only short pulses, but also high instantaneous photon intensity. When the time averaged photon intensity cannot be increased, the required threshold for the instantaneous intensity could nevertheless be reached (and the time resolution improved), if the time duration of individual photon pulses could be reduced without losing significant numbers of photons in the process. The term "equitemporal optics" denotes a collection of optical elements which can bring about a photon pulse length compression of this type. We demonstrate in general that practical equitemporal optics for x rays requires at least one optical element which is nonstationary. It is also shown that an equitemporal optics can be constructed for x rays by making use of only a single rotating mirror, while all other elements are stationary, provided that at least one of the stationary elements is a reflector. Furthermore, that reflector cannot be a single continuous mirror, but must contain more than one appropriately positioned discontinuous section. The number of sections must not be less than the time compression factor, f_t, by which the original pulse length is to be reduced. Examples of appropriate reflectors are given. An equitemporal design of this type is presented which utilizes such a reflector together with a mirror rotating with a constant angular velocity. The time compression factor of this device is calculated.

43293 Properties and applications of fast rotors in dynamical optics (abstract). Csonka, P. L. (Institute of Theoretical Sciences, University of Oregon, Eugene, Oregon 97403-5203 (US)). *Review of Scientific Instruments (USA),* 60(7): 1994-1994 (Jul 1989).

The term "dynamical optics" is defined as a set of optical elements at least one of which is nonstationary as seen from the laboratory. Present technology allows the construction of fast rotating mirrors as components in dynamical optical systems. Calculations show that such systems can be used to achieve subpicosecond x-ray pulses and extremely high instantaneous intensities, and, alternatively they can be utilized to saturate the transverse coherence of x-ray beams thereby making possible to perform certain interference experiments. Some properties and additional applications of fast rotating mirrors are discussed: (1) The focusing properties of rotating mirrors can differ significantly from those of stationary reflectors, even though the mirrors are, of course, nonrelativistic. A small (diameter <1 mm) plane mirror when rotating can have a focal length f_m down to a few meters. By changing the speed of rotation, the focal length can be altered continuously from its minimum value, f_m, through infinity (when the mirror is at rest) to $-f_m$ (when it's rotation is reversed). Thus, mirrors can be constructed which can be made to both focus and defocus with continuously and accurately variable focal length. (2) Rotating mirrors will induce a frequency change $\Delta\omega$ in the reflected beam, allowing one in principle to tune across resonance lines, and also "active monochromatization" of x-rays, i.e., increasing the spectral intensity in a selected range, while decreasing it outside that range, all this without any change in the total photon beam intensity. This option is of interest when the total photon intensity cannot be increased beyond a certain limit, high resolution monochromatization is available, and large spectral density is called for in a chosen frequency range.

43294 Use of simultaneous reflections for precise absolute energy calibration of x rays. Arthur, J. (Stanford Synchrotron Radiation Laboratory, Stanford, California 94309 (US)). *Review of Scientific Instruments (USA),* 60(7): 2062-2063 (Jul 1989). DOE Contract AC03-82ER13000.

An experimental study of intensity variations in a synchrotron x-ray beam caused by the presence of simultaneous reflections in the silicon monochromator crystals has been compared with calculations based on dynamical diffraction theory in an effort to determine the practical limits to the use of such intensity variations for energy calibration. It has been found that relative misalignments of the monochromator crystals can lead to errors of approximately 0.01% (1 eV at 10 keV), but that with some care energy calibration to within 0.002% (0.2 eV at 10 keV) can be achieved in a short measurement.

43295 Double-crystal monochromator for a PF 60-period soft x-ray undulator (abstract). Ishikawa, T. (Photon Factory, National Laboratory for High Energy Physics, Japan (US)); Maezawa, H.; Nomura, M.; Ando, M. *Review of Scientific Instruments (USA),* 60(7): 2129-2129 (Jul 1989).

Since undulator light is sharply collimated itself, it can be effectively monochromatized by a perfect crystal. An x-ray double-crystal monochromator with a fixed exit has been designed and built for the use of undulator light from a 60-period undulator at Photon Factory (beamline 2A). Available Bragg angle ranges from 7° to 80°. Angle scan is made by means of a goniometer outside the vacuum chamber, with the finest step of 0.1 arcsec. Magnetic fluid is used as the vacuum seal of the feedthrough. The fixed exit beam position is kept by translating the second crystal along the two mechanical guides: one for normal and the other for parallel to the crystal surface. Adjustment of the parallelity of two crystals is made manually with flexible wires. Since a total power in the central coherent portion which is limited by a $1 \times 1\text{-mm}^2$ slit is not so much, a stable operation is possible without cooling the crystal. Currently, InSb (111) reflection is used. The diffracting planes of the first cyrstal is 1° off from the surface and the second is the symmetric reflection. At its fifth harmonics, brilliant undulator light of approximately 10^{12} photons/s mm^2 with 1-eV energy resolution is available (E=2 keV).

43296 Infrared synchrotron radiation measurements at Brookhaven. Williams, G. P. (National Synchrotron Light Source, Brookhaven National Laboratory, Upton, New York 11973 (US)); Hirschmugl, C. J.; Kneedler, E. M.; Sullivan, E. A.; Siddons, D. P.; Chabal, Y. J.; Hoffman, F.; Moeller, K. D. *Review of Scientific Instruments (USA),* 60(7): 2176-2178 (Jul 1989). DOE Contract AC02-76CH00016.

We describe the spectrometer and experimental stations on the infrared beamline (IR4) at the National Synchrotron Light Source, Brookhaven. We also report measurements of the source characteristics in the range 30–400 μm (25–350 cm^{-1}), including both flux and brightness and compare them with corresponding measurements from a 1000-K blackbody source.

43297 Performance of a tuneable secondary x-ray spectrometer. Brennan, S. (National Bureau of Standards, Quantum Metrology Division, Gaithersburg, Maryland 20899 (US)); Cowan, P. L.; Deslattes, R. D.; Henins, A.; Lindle, D. W.; Karlin, B. A. *Review of Scientific Instruments (USA),* 60(7): 2243-2246 (Jul 1989). DOE Contract AC02-76CH00016.

An efficient, high-resolution secondary x-ray spectrometer is critical to studies of x-ray-excited fluorescent x-ray emission spectra. Even with the highest available incident flux of x rays, the signal count rate can become unacceptably low when dispersed by an analyzing crystal. This problem is most serious in studies of gas targets, or at low energies where fluorescence yields are low. We have characterized the performance of a spectrometer based on the Rowland circle geometry with a variable-radius curved (Johann) analyzing crystal. A position-sensitive detector was used so that counts at a range of points on the Rowland circle corresponding to different wavelengths can be recorded in parallel. The efficiency of the spectrometer permits the observation of weak processes, such as subthreshold elastic and elastic x-ray scattering from gases. Energy resolution at low energies is sufficient to allow observations of spectral peak widths which are narrower than lifetime broadening widths. Polarization dependence of the fluorescence can also be studied.

43298 Virtual phase CCD x-ray detectors. Clarke, R. (Department of Physics, The University of Michigan, Ann Arbor, Michigan 48109 (US)); Rodricks, B.; Smither, R. *Review of Scientific Instruments (USA),* 60(7): 2280-2283 (Jul 1989). DOE Contract W-31-109-ENG-38.

A two-dimensional charge-coupled device (CCD) detector, based on the Texas Instruments "virtual phase" CCD, has been developed at the University of Michigan for synchrotron radiation applications. A series of performance tests were carried out at the LURE synchrotron facility, and the results show that the detector is ideally suited to measurements in dispersive absorption spectroscopy, high-resolution diffuse scattering, and small-angle scattering. The characteristics of the detector also show great promise for time-resolved experiments.

43299 X-ray microtomography on beamline X at SSRL. Kinney, J. H. (Lawrence Livermore National Laboratory, Livermore, California 94550 (US)); Johnson, Q. C.; Nichols, M. C.; Bonse, U.; Saroyan, R. A.; Nusshardt, R.; Pahl, R. *Review of Scientific Instruments (USA),* 60(7): 2471-2474 (Jul 1989). DOE Contract W-7405-ENG-48.

This article describes a high-resolution three-dimensional CT system which has been tested on the new wiggler beamline X-2 at the Stanford Synchrotron Radiation Laboratory. The present system is a rotate-only design which uses a virtual phase CCD array camera optically coupled to a high-resolution phosphor screen. The spatial resolution of this system is presently somewhat better than 10 μm (50 line pairs/mm at 20% contrast). This resolution is limited by the optical elements in the detector, and we are undertaking an effort to improve this resolution to 1 μm. Nevertheless, the spatial resolution offered by this design is sufficient to begin many studies of interest to materials research, such as, supported catalysts, composite materials, and crack growth and propagation.

43300 Optimization of CCD-based energy-modulated x-ray microtomography. Bonse, U. (Institute of Physics, University of Dortmund, Federal Republic of Germany (DE)); Nusshardt, R.; Busch, F.; Pahl, R.; Johnson, Q. C.; Kinney, J. H.; Saroyan, R. A.; Nichols, M. C. *Review of Scientific Instruments (USA),* 60(7): 2478-2481 (Jul 1989).

Employing asymmetric Bragg reflection at the monochromator we obtain a wide and practically parallel synchrotron-radiation beam which, when combined with the use of a CCD detector, enables us to perform chemically specific, high-speed and high-resolution tomography. We present recent results obtained with this new method. The actual resolution achieved was determined from the measured line-spread function of the complete detection system which includes the CCD, the fluorescent screen, and the lens used for optical magnification. The modulation-transfer function (MTF) calculated from the line-spread function shows that with only twofold magnification and at 3% contrast detectability about 28 line pairs per mm are resolved. Extrapolating from this result we find that with an optical magnification of 7:1 about 100 line pairs per mm should be resolved. Ways to optimize the method further are discussed.

43301 Soft-x-ray imaging with the 35 period undulator at the NSLS. Buckley, C. (NSLS, Brookhaven National Laboratory, Upton, New York 11973 (US)); Rarback, H.; Alforque, R.; Shu, D.; Ade, H.; Hellman, S.; Iskander, N.; Kirz, J.; Lindaas, S.; Mcnulty, I.; and others. *Review of Scientific Instruments (USA),* 60(7): 2444-2447 (Jul 1989). DOE Contract AC02-76CH00016.

In the summer of 1988, the National Synchrotron Light Source installed a 35 period soft-x-ray undulator. We are using this device as a radiation source for a beamline designed for soft-x-ray imaging experiments that require high brightness for practical operation. We present the design philosophy and implementation of this beamline. Preliminary characterization of the beamline and undulator indicate that the central intensity of the undulator is within a factor of 2 of design. We have measured an intensity of more than 10^{15} photons/s/0.1% BW/mrad^2 at 36 A. The monochromator has achieved its design resolving power of 2000.

43302 An improved double fluorescence detector for fluorescence EXAFS measurements. Heald, S. M. (Brookhaven National Laboratory, Upton, New York 11973 (US)). *Review of Scientific Instruments (USA),* 60(7): 2509-2510 (Jul 1989). DOE Contract AS05-80ER10742.

In many cases the fluorescence EXAFS signal is contaminated with fluorescence from nearby elements. If this fluorescence is of lower energy than the element of interest, x-ray filters are not effective. One method for dealing with this problem is the double fluorescence method described by Wong and Rao. This paper describes an improved version of this double fluorescence scheme that greatly improves its efficiency. Data are presented for a sample of 1/2% Hf in Ni_3 Al, and 1.6% CuO in NiO. When standard fluorescence is used, both signals are almost completely obscured by the $\cong$100 x larger Ni *K* fluorescence signal. With the double fluorescence detector the Hf L_3 and Cu *K*-edge signals are clearly observed, and good spectra can be obtained in about an hour.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

Refer also to citation(s) 43244

43303 (CONF-890814–1) **Use of waste energetic materials as a fuel supplement in utility boilers.** Myler, C.A.; Bradshaw, W.M.; Cosmos, M.G. Oak Ridge National Lab., TN (USA). 1989. 21p. Sponsored by DOD;DOE/ER. DOE Contract AC05-84OR21400. From American Institute of Chemical Engineer's summer national meeting; Philadelphia, PA (USA); 20-23 Aug 1989. Order Number DE89016080/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

Waste energetic material produced during the manufacture of explosives has been considered a by-product waste which must be disposed of. Methods such as open buring or open detonation pose potential environmental risks while disposal in specially designed hazardous waste incinerators is costly. No current method capitalizes on these materials' inherent energy capacity. Efforts to utilize these wastes as supplements to fuel oil are under way. Laboratory and bench scale operations verify the principle while economic analysis shows a positive advantage using this approach. Pilot scale testing is underway to develop fuel mixing/feeding procedures and to determine fuel mixture energy parameters. 9 refs., 6 figs., 2 tabs.

43304 (LA-UR–89-2567) **A study on the contribution of slow reaction in detonation.** Tang, P.K.; Seitz, W.L.; Stacy, H.L.; Wackerle, J. Los Alamos National Lab., NM (USA). 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890812–3: American Physical Society topical conference on

shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89015280/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Interface velocimetry and plate push experiments of the TATB-based explosives investigated so far show the presence of nonsteady detonation; namely, the initial velocity history increases with increasing explosive charge length, a condition generally attributed to the variation of effective CJ pressure. A multistage reaction model is used to simulate these experiments. For these explosives, we find that the reaction must include a slow process stage so that the numerical results can be brought into good agreement with experimental observation. 8 refs., 7 figs.

43305 (ORNL/FTR–3333) **[Chemical explosives detection and analysis (mostly by mass spectrometry), Salford, England and Mannheim, West Germany, June 30, 1989–July 15, 1989]: Foreign trip report.** McLuckey, S.A. Oak Ridge National Lab., TN (USA). 20 Jul 1989. 17p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. Order Number DE89015399/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler attended the Triennial International Dynamic Mass Spectrometry Symposium in Salford, England, and presented a paper on the analysis of negative ions using an ion trap mass spectrometer. The emphasis of the meeting was on time-of-flight mass spectrometry and ion trap mass spectrometry. Both techniques are used in the ORNL explosives detection effort. Discussions outside of the meeting resulted in an idea that may lead to a breakthrough in our ion injection work with dramatic benefits to explosives detection. The traveler then attended the Third International Symposium on Analysis and Detection of Explosives in Mannheim, West Germany and presented a paper on the latest research at ORNL in explosives vapor detection.

43306 (UCRL–101025) **Protecting x-ray diagnostic film in high-explosive experiments.** Cook, C.F. III; Urquidez, E. Lawrence Livermore National Lab., CA (USA). 17 May 1989. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890885–7: Flash radiography topical symposium, Portland, OR (USA), 15-18 Aug 1989). Order Number DE89016651/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Flash x-ray radiography is one of the most important diagnostic tools in high-explosive testing. To obtain high-quality radiographs it is necessary to protect the film pack from motion or damage, which can produce artifacts on the radiographic image. We describe a very effective method of film recovery, based on momentum transfer, that we have developed. We also use other techniques, described here, to help ensure the quality of the film image. 6 figs., 1 tab.

4502 Nuclear

Refer also to citation(s) 43013, 43014, 43015, 43675, 44171, 44405

43307 (AD-A–206013/5/XAB) **Communication facility EMP (electromagnetic pulse) assessment. Topical report, 1 September 1975-30 March 1979.** Boeing Aerospace Co., Seattle, WA (USA). 30 Mar 1979. 75p. Available from NTIS, PC A04/MF A01.

Availability: Document partially illegible.

A scenario-variant EMP assessment was performed for the Technical Control Facility and Microwave Terminal. Elements located at the EMP assessment considered the effects induced by EMP environments generated by high-altitude nuclear detonations. The EMP assessment identifies the critical electrical/electronic equipment predicted to be impaired by the largest signals induced within the facility by any high-altitude nuclear EMP environment.

43308 (AD-A–206093/7/XAB) **Spectral and temporal fidelity of a hard x-ray weapons effects simulation test in a high-gain ICF (inertial confinement fusion) facility. Master's thesis.** Nichols, D.F. Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering. Mar 1989. 92p. (AFIT/GNE/ENP–89M-6). Available from NTIS, PC A05/MF A01.

The MORSE-CG Monte Carlo code was used to simulate the effects of hard X rays from a nuclear weapon. Facility will be an inertial confinement fusion facility for the testing of high-gain deuterium-tritium (DT) pellets, and will produce a pulse of hard X rays and neutrons over a very short time interval. A spherical shell for ^{6}LiH with a thickness of 60 cm was found to spread an instantaneous 10-keV X-ray pulse temporally over a period of 16 ns. The peak of the X-ray spectrum shifted down in energy from the 37.5 keV peak of the input spectrum to a final energy of 25 keV. Eighty-seven percent of the source X-ray intensity was lost to the LiH, resulting in a final fluence of 10.8 cal/sq cm and a final dose of 9.3 Mrads(Si) 250 cm from the source. Fifty percent of the X-ray dose arrived during an interval of 6 ns, giving a dose rate of 8 x 10 to the 14th power rads (Si)/sec. The only serious problem with the use of the LMF for hard X-ray simulation was the fluence of one-MeV-equivalent neutrons. The minimum fluence achieved was on the order of 10^{14} n/sq cm.

43309 (AD-A–206094/5/XAB) **Parallel Ada implementation of a multiple-model Kalman-filter tracking system: a software engineering approach. Master's thesis.** Lemanski, W.J. Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering. Mar 1989. 120p. (AFIT/GCS/ENG–89M-2). Available from NTIS, PC A06/MF A01.

The success of the Strategic Defense Initiative depends directly on significant advances in both computer hardware and software development technologies. Parallel architectures and the Ada programming language have advantages that make them candidates for use in SDI command and control computer systems. This thesis examines those advantages in the context of an SDI-type application: implementation of a Kalman-filter tracking system. This research consists of three parts. The first is a set of software engineering guidelines developed for use in creating parallel designs suitable for implementation in Ada. These guidelines cover the design process from initial problem analysis to final detailed design. Methods of problem decomposition are discussed, as are language partitioning strategies. Justification is provided for using the Ada task construct for process boundaries, and Ada multitasking design issues are reviewed. A parallel software design methodology is also described.

43310 (AD-A–206211/5/XAB) **Radiation-response prediction of single-mode fibers. Final technical information bulletin.** Friebele, E.J. Naval Research Lab., Washington, DC (USA). Optical Sciences Div. Mar 1988. 247p. Available from NTIS, PC A11/MF A01.

Fiber-optic transmission systems, because of their extraordinary channel capacity and decreasing cost, are rapidly becoming the preferred terrestrial transmission media of the nation's long distance, inter-city telecommunications infrastructure. Since the commercial telephone network forms the foundation for emergency communication in the event of a national crisis or emergency, additional requirements are placed on the fibers and components being installed. One of the most stressing environments for the fiber consists of fallout subsequent to a nuclear attack. The susceptibility of some of types of commercially available fiber optic cable to optical darkening (and hence increased signal loss) from exposure to ionizing radiation raises serious questions about the survivability of such systems in the reconstitution phase of a nuclear conflict. There is a large body of knowledge available on the effects of gamma radiation on the older multimode fiber cables. However, there are critically important knowledge gaps with respect to the newer single-mode cables employed in the inter-city fiber-transmission links being installed today. This document is a final report of a two-year program funded by NCS at Naval Research Laboratory, which was the first systematic study of the interrelationship of fiber, fabrication parameters and radiation-induced loss. A rudimentary regression model was developed for predicting the loss induced by a fallout exposure at -35 C.

43311 (AD-A–206265/1/XAB) **Solution of two-dimensional, two-region electromagnetic ground response. Final report, March-August 1987.** Kohlberg, I. Battelle Columbus Labs., Research Triangle Park, NC (USA). Mar 1989. 42p. (BATT-TCN–87-116). Available from NTIS, PC A03/MF A01.

A solution for the two-dimensional, two-region electromagnetic ground response was developed that relates the surface components of the electric field to the surface components of the magnetic field. This has been accomplished by deriving a universal functional form for a dimensionless Green's function. The Green's function provides increasingly more accurate approximations to the response

for each successive reflection from the second layer. This result would appear to provide simplification and reduced computer running time in the numerical modelling of the HABEMP when the ground response is coupled to finite-difference methods for solving the atmospheric part of the problem.

43312 (AD-A-206355/0/XAB) **Response of layered structures to thermal-radiation pulses. Master's thesis.** Jodoin, V.J. Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering. Mar 1989. 94p. (AFIT/GNE/ENP-89M-3). Available from NTIS, PC A05/MF A01.

An approximation to the response of composite or layered structures to thermal radiation from a nuclear device was developed. The model developed uses the Extrapolated Crank-Nicolson unconditionally stable implicit finite-difference scheme to approximate the nonlinear parabolic partial differential heat transfer equation. The model allows for convection at the front face and assumes the back face is insulated. The model assumes one-dimensional heat conduction in Cartesian coordinates. The program approximates Glasstone's thermal pulse shape and uses it and two different moments-matched pulses for the incident thermal radiation. The program was used to do a sensitivity analysis of pulse shape on response. The program uniquely handles the interface conditions to match the Crank-Nicolson accuracy and stability. The program was developed to be run for various thermal fluences and weapon yields. The results showed that the early transients are dependent on pulse shape. The temperature profile in the structure at the approximate time of blast arrival was not dependent on pulse shape however. It was also shown that the nonlinearity affected the peak temperature at the front face. Theses. (mjm)

43313 (AD-A-206549/8/XAB) **Fallout radiation effects analysis methodology. Final report.** National Communications Systems, Washington, DC (USA). 31 Mar 1988. 71p. (NCS-TIB-88-04). Available from NTIS, PC A04/MF A01.

Fallout radiation is viewed by the weapons effects community as a potentially serious impediment to maintaining or restoring critical National Security Emergency Preparedness (NSEP) telecommunication capabilities in a nuclear environment. The OMNCS' Electromagnetic Pulse Mitigation Program is designed, in part, to identify the survival probability (survivability) of the nation's NSEP telecommunications infrastructure against fallout radiation effects. The OMNCS (Office of the Manager National Communications System) is developing a balanced approach consisting of fallout radiation stress tests on the electronic piece-parts and the use of estimated performance measures of telecommunication network elements in network simulation models to predict user connectivity levels. It is concluded that, given limited available data, the proposed method can predict fallout radiation effects on network telecommunication equipment. The effects of fallout radiation are small at low dosage levels (bin 1 and bin 2). More pronounced variations in equipment performance were exhibited for radiation dosage in the 1k-5k Rads(Si) bin. Finally, the results indicate that by increasing the sample size to approximately 200 samples, the statistical quality of survivability predictions can be significantly improved.

43314 (AD-A-206714/8/XAB) **Communication facility EMP assessment. Topical report, 1 September 1975-30 March 1979.** Boeing Aerospace Co., Seattle, WA (USA). 30 Mar 1979. 67p. Available from NTIS, PC A04/MF A01.

A scenario variant EMP assessment was performed for the facility. The EMP assessment considered the equipment effects induced by EMP environments generated by high-altitude nuclear detonations. The scenario-variant technique identifies the critical electrical/electronic equipment predicted to be impaired by the largest signals induced within the facility by any high-altitude nuclear EMP environment. Electromagnetic pulse hardening is recommended to insure that all critical equipments will maintain their operational capabilities during and after an EMP illumination of the facility. Hardening design packages are provided such that, if implemented, the functional capabilities of the facility will survive the most severe high-altitude EMP.

43315 (AD-A-206715/5/XAB) **Communication facility EMP assessment. Topical report, 1 September 1975-30 March 1979.** Boeing Aerospace Co., Seattle, WA (USA). 30 Mar 1979. 67p. Available from NTIS, PC A04/MF A01.

Availability: Document partially illegible.

The Commander-in-Chief and the Defense Nuclear Agency (DNA) have undertaken an Assessment of Communications for Hardening to Electromagnetic Pulse to assess the vulnerability of the Command's Command, Control, Communications and Computer (C4) Networks to electromagnetic pulses from high-altitude nuclear bursts and to provide recommendations for hardening as may be required. Networks are used to link with the National Command Authority (NCA), subordinate and component headquarters, and the forces. The Boeing Aerospace Company has developed and validated analytical techniques to predict the functional responses of a communications facility to the electromagnetic pulse (EMP) environments produced by a high-altitude nuclear-weapon-detonation scenario. The analytical capability has been applied to selected elements of the C4 Networks to develop response predictions in terms of upset and damage of facility equipment and functional impairments of facility communications capabilities.

43316 (AD-A-206952/4/XAB) **Effects of high-altitude electromagnetic pulse (HEMP) on telecommunications assets. Final Technical Information Bulletin.** Booz, Allen and Hamilton, Inc., Bethesda, MD (USA). Jun 1988. 114p. Available from NTIS, PC A06/MF A01.

Supersedes Rept. No. NCS-TIB-87-15, AD-A196 914.

The objective of the Electromagnetic Pulse (EMP) Mitigation Program is the removal of EMP as a significant impediment to timely reestablishment of regional and national telecommunications following an attack against the United States that includes high-altitude nuclear detonations. The program approach involves estimating the effects of High-altitude EMP (HEMP) on telecommunication connectivity and traffic-handling capability, assessing the impact of available HEMP mitigation alternatives, and developing a comprehensive plan for implementating mitigation alternatives. This report summarizes available test results as they apply to the EMP Mitigation Program, and supercedes all previous versions of this report.

43317 (AD-A-206971/4/XAB) **Equipment level fallout radiation-effects approach. Final report.** Booz, Allen and Hamilton, Inc., Bethesda, MD (USA). 10 Feb 1989. 54p. Available from NTIS, PC A04/MF A01.

National Security Decision Directive (NSDD) 97 and Executive Order (EO) 12472 call for the ability to maintain National Security Emergency Preparedness (NSEP) communication capabilities in times of national disaster, which includes a nuclear attack. The Office of the Manager, National Communications System (OMNCS) sponsors the Electromagnetic Pulse (EMP) Mitigation Program to evaluate and, where possible, mitigate the effects of the nuclear attack. Fallout radiation has been identified as an environment that may effect the performance of the regional and national telecommunication system. This report presents the investigations in the network-level fallout radiation methodology used to determine the effects of this environment. Alternative techniques are presented to improve the methodology.

43318 (AD-A-955412/2/XAB) **Soviet post-attack recovery: an initial assessment. Final report, February 1976-May 1978.** Earle, M.M.; Hunter, H. SRI International, Arlington, VA (USA). Strategic Studies Center. May 1978. 44p. (SRI-W-78-17302). Available from NTIS, PC A03/MF A01.

This Technical Note examines the applicability of using an econometric model in the evaluation of the recovery potential of the Soviet Union following a nuclear war. Specific observations are made concerning the limitations of such an analytical tool in assessing intersectoral differences during recovery and improvements needed in an econometric model constructed for examining peacetime economic processes if features of recovery phenomena are to be properly treated. Contents: Basic Characteristics of this Approach to Economic Analysis of the Postattack-Recovery Process; A Brief Description of SOVMOD II; Results of Selected Tests Used in SOVMOD II; Detailed Recovery Phenomena within the Industrial Sector; Major Limitations of SOVMOD II for Recovery Analysis.

43319 (AD-A-955415/5/XAB) **Survivability and employment of tactical nuclear and conventional airpower in central NATO**

(North Atlantic Treaty Organization). Phase 1. DNA/USAF (Defense Nuclear Agency/United States Air Force) program. Volume 1. Summary. Final report, October 1975-September 1976. Greene, T.E. R and D Associates, Marina del Rey, CA (USA). Dec 1976. 158p. (RDA-TR-101800-010). Available from NTIS, PC A08/MF A01.

Availability: Document partially illegible.

NATO/security; NUCLEAR WEAPONS; CONVENTIONAL WARFARE; AIRPORTS; NATO; SECURITY; VULNERABILITY; CHEMICAL WARFARE; PROGRESS REPORT

43320 (AD-A-955418/9/XAB) **Tactical nuclear warfare studies. Final report, March-September 1975.** Shannon, J.A.; Douglass, J.D.; Adelman, F.L. System Planning Corp., Arlington, VA (USA). 30 Sep 1975. 66p. (SPC-234-SAN). Available from NTIS, PC A04/MF A01.

Availability: Document partially illegible.

WARFARE; NUCLEAR WEAPONS/warfare; WARFARE; DAMAGE; VULNERABILITY; NUCLEAR EXPLOSIONS; FOREIGN POLICY; USSR; MILITARY STRATEGY; PROGRESS REPORT

43321 (UCRL-52000-88-10, pp. 30-36) **Imaging in the nuclear test program.** Frerking, E. Lawrence Livermore National Lab., CA (USA). Oct 1988. In *Energy and technology review.* Order Number DE89005308/JAW. Available from NTIS, PC A03/MF A01.

The acquisition, processing, and display of data in the form of images has become increasingly important to the Nuclear Test Program. Using inexpensive new computer-imaging tools, every portion of the cycle of camera preparation, data collection, and data processing are performed more easily, speedily, and comprehensively than before. With these new capabilities one can perform new experiments. This increase in processing power promises to be a continuing trend that will enable the new experiments to answer old and puzzling questions about the physics of nuclear designs. 9 figures.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

Refer also to citation(s) 42224, 43350, 43723, 43757

43322 (ACUNS-8701, pp. 17-49) **Climatic variation and change and implications for arctic heritage planning strategies.** LeDrew, E.F. Association of Canadian Universities for Northern Studies (ACUNS), Ottawa, ON (Canada). 1987. (CONF-8508276-: Arctic heritage, Banff (Canada), 24-28 Aug 1985; MICROLOG-87-03004). In *Arctic heritage. Proceedings of a symposium.* Available from Association of Canadian Universities for Northern Studies, 130 Albert Street, Ottawa, ON, CAN K1P 5G4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Arctic regions are particularly vulnerable to climatic variability and change. This has important implications for the management of natural resources and the development of man's habitation in Canadian North. As a consequence of the nature of the feedbacks between the cryosphere the atmosphere and the ocean, the climate is significantly more sensitive in the Arctic than elsewhere to any perturbations within the climatic system. Scenarios are being developed on the basis of numerical simulations of the atmosphere and the study of past climates as analogues in an effort to understand the nature of the nature of the variability or change and to give insight into the probable consequences. Essential variables involved in these feedbacks include the CO_2 and particulate loading of the atmosphere, the extent of the pack ice, deforestation of the boreal forest and the general circulation of the atmosphere and ocean. In this paper, the factors contributing to the sensitivity of the arctic climate to variability and change have been reviewed. The directions of research required to provide more confident answers to questions related to planning in the Canadian Arctic have been discussed. Of particular concern is the dearth of traditional data with sufficient temporal and spatial resolution. Hemispheric surveillance using repetitive remote sensing is necessary to examine regional scale processes. Intensive study is proposed of key ecological areas such as refugia and thermal oases as well as anomalous phenomena such as the North Water. 92 refs., 9 figs., 1 tab.

43323 (AD-A-206236/2/XAB) **SHARC (Strategic High-Altitude Radiance Code). A computer model for calculating atmospheric radiation under non-equilibrium conditions.** Sharma, R.; Ratkowski, A.J.; Sundberg, R.L.; Duff, J.W.; Bernstein, L.S. Air Force Geophysics Lab., Hanscom AFB, MA (USA). Feb 1989. 22p. (AFGL-TR-89-0083). Available from NTIS, PC A03/MF A01.

The Strategic High-Altitude Radiance Code (SHARC) is a new computer code that calculates atmospheric radiation for paths from 60 to 300 km altitude in the 2-40 micro spectral region. It models radiation due to NLTE (Non-Local Thermodynamic Equilibrium) molecular emissions which are the dominant sources at these altitudes. The initial version of SHARC, which is described in this paper, includes the five strongest IR radiators, CO_2, NO, O_3, H_2O and CO. Calculation of excited state populations is accomplished by interfacing a Monte Carlo model for radiative excitation and energy transfer with a highly flexible chemical kinetics module derived from the Sandia CHEMKIN Code. An equivalent-width, line-by-line approach for the radiation transport gives a spectral resolution of about 0.50/cm. The radiative-transport calculation includes the effects of combined Doppler-Lorentz (Voigt) line shapes. Particular emphasis was placed on modular construction and supporting data files so that models and model parameters can be modified or upgraded as additional data become available. The initial version of SHARC is now ready for distribution.

43324 (DFVLR-Mitt.-89-04) **5th user seminar of the German Remote Sensing Data Center of DFVLR. Proceedings.** Winter, R.; Markwitz, W. Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.). Feb 1989. 116p. (In German). Order Number DE89796108/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; NTIS (US Sales Only), PC A06/MF A01.

From June 6 to June 7, 1988 the 5th user seminar of the German Remote Sensing Data Center of DFVLR took place in Oberpfaffenhofen. The application potential of satellite data of NOAA-, LANDSAT- and SPOT satellites was presented in 21 papers. The main emphasis was put on the evaluation of NOAA-data for meteorological and oceanographic applications and investigations of Federal Government Agencies into planning, inventory, monitoring, statistical census and geoscientific developing aid. (orig.) With 38 figs., 4 tabs., 50 refs.

43325 (DOE/PC/79668-T4-Vol.1-Exec.Summ.) **Conceptual design of a coal-fired MHD retrofit plant (Scholz Plant - Sneads, FL): Volume 1, Final report.** Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div. Apr 1989. 296p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-87PC79668. Order Number DE89015742/JAW. Available from NTIS, PC A13/MF A01 - OSTI; GPO Dep.

Westinghouse Advanced Energy Systems (WAES), through Contract No. AC22-87PC79668, has completed a conceptual design study to evaluate a coal-fired MHD retrofit of a utility plant of sufficient size to demonstrate the technical and future economic viability of an MHD system operating within an electric utility environment. The utility plant considered in this study is the Scholz Generating Station which is owned and operated by Gulf Power Company, a member of the Southern Company. The design team was comprised of the following members: Southern Electric International (the architectural engineering arm of the Southern Company), University of Tennessee Space Institute (UTSI), SciTec Inc., HMJ Corporation, STD Research Corporation, and Westinghouse R&D. This report, a contract deliverable, documents the efforts of this team over a period of performance from October 1987 through April 1989.

43326 (EC-87-01) **Canadian climate impacts program.** Environment Canada, Ottawa, ON (Canada). 1987. 37p. (In English and French). (MICROLOG-87-04818). Available from Canada. Atmospheric Environment Service, Climatological Services Division, Terrasses de la Chaudie@'re, 10 Wellington St., Hull, PQ, CAN

K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In recognition of the impact of climate and climatic fluctuations on society, a Canadian Climate Program was established in 1978 to integrate the efforts of various federal and provincial agencies, as well as the universities and private sector, in the field of climatology. One of the program's main components since 1984 has been research to assess and identify the potential social and economic impacts of climate warming expected under a doubled carbon dioxide scenario. These and other studies over the last several years have clearly shown that increasing greenhouse gas concentrations have the potential for profound impacts on Canada's physical environment. However, they also show that there is considerable uncertainty associated with the magnitude of the expected climate warming and with understanding the relationships between climate, the biophysical environment, and socioeconomic systems. This report summarizes the program and specific studies including those on the impact of climate change on navigation and power generation, agriculture, tourism and recreation, and the marine environment.

43327 (GKSS–89/E/7) **Framework of cloud parameterization including ice for 3-D mesoscale models.** Levkov, L.; Jacob, D.; Eppel, D.; Grassl, H. GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). 1989. 50p. Order Number DE89911495/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A03/MF A01.

A parameterization scheme for the simulation of ice in clouds incorporated into the hydrostatic version of the GKSS three-dimensional mesoscale model. Numerical simulations of precipitation are performed: over the Northe Sea, the Hawaiian trade wind area and in the region of the intertropical convergence zone. Not only some major features of convective structures in all three areas but also cloud-aerosol interactions have successfully been simulated. (orig.) With 19 figs., 2 tabs.

43328 (GSF–17/88) **Dispersion and effects of photooxidants in the Alpine regions. Proceedings.** Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU). Jun 1988. 699p. (In German). (CONF-8804293–: International symposium on dispersion and effects of photooxidants in the Alpine regions, Garmisch-Partenkirchen (Germany, F.R.), 11-15 Apr 1988). Order Number DE89795432/JAW. Available from NTIS (US Sales Only), PC A99/MF A01; NTIS (US Sales Only), PC A99/MF A01.

This compendium of reports comprises 42 lectures held at the international meeting as well as 13 contributions in the form of posters, mainly all of which are in the German language. The significance of the photochemical oxidants as one of the main causes for damage to mountain forests is investigated. The following main topics were dealt with at the symposium: (A) survey of the damage to the forests in some Alpine countries; (B) emission of precurser substances and ozone; (C) formation, conversion and transport of photochemical oxidants; (D) immission of ozone; (E) integrating measuring methods; (F) effect on plants; (G) ecological reflections and future strategies. (RB).

43329 (INIS-mf–11991) **Numerical modeling of atmospheric washout processes.** Berichte des Zentrums fuer Umweltforschung. Bayer, D.; Beheng, K.D.; Herbert, F. Frankfurt Univ. (Germany, F.R.). Zentrum fuer Umweltforschung. Sep 1987. 82p. (In German). Order Number DE89911031/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Also published as report no. 70 of the Institut fuer Meteorologie und Geophysik, Frankfurt Univ. (Germany, F.R.).

For the washout of particles from the atmosphere by clouds and rain one has to distinguish between processes which work in the first phase of cloud development, when condensation nuclei build up in saturated air (Nucleation Aerosol Scavenging, NAS) and those processes which work at the following cloud development. In the second case particles are taken off by cloud droplets or by falling rain drops via collision (Collision Aerosol Scavenging, CAS). The physics of both processes is described. For the CAS process a numerical model is presented. The report contains a documentation of the mathematical equations and the computer programs (FORTRAN). (KW).

43330 (Juel-Spez–492) **Impact of green on the urban atmosphere in Athens.** Scientific series of the International Bureau. Horbert, M.; Kirchgeorg, A.; Chronopoulou-Sereli, A.; Chronopoulos, J. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. 187p. Available from Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek.

Ten climate stations were run in the Athens area from May, 1984 to April, 1985. In addition, data from 3 stations belonging to the Greek Meterological Service were employed. Numerous temporary readings were made at another 580 locations in various weather conditions and at various times of day between April and September, 1984, using two mobile climate measuring units. These data provided the basis for area-covering maps for the parameters of temperature and vapor pressure, as well as wind distribution maps for the greater Athens area in various weather conditions on a scale of 1:10,000. The data were correlated with the location of the measuring stations in the greater area and relief, the various types of construction and area use, the amount of open spaces, as well as the type of vegetation. In so doing, it was possible to determine which factors contribute to pollution or improvement of the bioclimate situation during periods of high pressure weather conditions occuring in the summer. With the help of special small-scale readings, the climatic effectiveness of green areas, were more closely investigated. (orig./KW).

43331 (NRC–27569) **Experimental lake area atmospheric corrosion program. Report for the period December 1984 - November 1985.** Hechler, J.-J.; Boulanger, J.; Noel, D. National Research Council of Canada, Ottawa, ON (Canada). 1987. 38p. Available from National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, ON, CAN K1A 0R6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Experimental Lake Area (ELA), near Kenora, Ontario was chosen in July 1984 to serve as a baseline site for an atmospheric corrosion program which is part of the US National Acidic Precipitation Program. This work is part of the Canadian Long Range Transport of Airborne Pollutants (LRTAP) research program and also one of the joint US-Canadian research project related to transboundary air pollution. This report gives the results of the first year of testing (December 1984 - November 1985). Two types of samples were exposed: 4-by-6 in. weight loss samples and 1-by-1.25 in. surface analysis samples of the following metals: mild steel, galvanized steel, galvalume, copper, aluminium and weathering steel. Two nitration and two sulfation plates were also exposed for periods of one month during the whole year. Two humidity sensors (Sereda type) were mounted on the testing rack to measure the time-of-wetness. Results show that the values obtained at ELA are lower than the least corrosive site in the USA, the New York site. A rapid glance at the air quality and precipitation chemistry also shows lower value of pollutants. Thus ELA seems to fulfil its requirements as a baseline site. 3 figs., 18 tabs.

43332 (SFB–210/ET-50) **Wind tunnel modeling of heat islands in a turbulent boundary layer.** Bloechl, B. Karlsruhe Univ. (T.H.) (Germany, F.R.). Sonderforschungsbereich 210 Stroemungsmechanische Bemessungsgrundlagen fuer Bauwerke. Jun 1988. 157p. (In German). Available from Karlsruhe Univ. (T.H.) (Germany, F.R.). Sonderforschungsbereich 210 Stroemungsmechanische Bemessungsgrundlagen fuer Bauwerke.

The basic studies of this report, had been done with a wind tunnel. Model similarity with typical atmospheric situations - such as an urban heat island - had to exist. Sufficient heat is needed to generate turbulent convection at the ground. By omitting the Boussinesq-approximation proper similarity parameters could be found to present the results in a dimensionless form. Also the effect of a cross circulation was investigated as well as the question at which conditions the convection is no longer able to overcome the longitudinal momentum of the wind. (KW).

43333 Aspects of regional-scale flows in mountainous terrain. Bossert, J. E. (Department of Atmospheric Science, Colorado

State University, Fort Collins, Colorado (US)); Sheaffer, J. D.; Reiter, E. R. *Journal of Applied Meteorology (USA)*, 28(7): 590-601 (Jul 1989).

Mountaintop data from remote stations in the central Rocky Mountains have been used to analyze terrain-induced regional (meso-β to meso-α) scale circulation patterns. The circulation consists of a diurnally oscillating wind regime, varying between daytime inflow toward, and nocturnal outflow from, the highest terrain. Both individual case days and longer terms averages reveal these circulation characteristics. The persistence and broadscale organization of nocturnal outflow at mountaintop, well removed from valley drainage processes, demonstrates that this flow is part of a distinct regime within the hierarchy of terrain-induced wind systems.

43334 Tributary fluxes into Brush Creek Valley. Coulter, R. L. (Center for Environmental Research, Biological, Environmental, and Medical Research Division, Argonne National Laboratory, Argonne, Illinois (US)); Orgill, M.; Porch, W. *Journal of Applied Meteorology (USA)*, 28(7): 555-568 (Jul 1989).

Measurements in a tributary to Brush Creek Valley during the September and October 1984 ASCOT campaign with laser anemometers, tethersondes, a minisodar, and smoke releases were used to calculate the contribution by tributaries to nocturnal drainage flow from the main valley. Four experimental nights with different mesoscale wind regimes were used in the study. It was found that a simple picture of mass flux proportional to drainage area is not sufficient to predict the relative contributions of drainage basins. The exposure of the slopes within the tributaries to the external wind regime was found to be a significant factor in the contribution of the upper regions of the tributary; but drainage from the well-protected lower region was found to irection than when the external wind was along the drainage direction. A circulation cell that introduces mass into the tributary system both from the main canyon flow and from the side opposite the main canyon flow is proposed to explain this effect.

43335 Micrometeorology of slope flows in a tributary canyon during the 1984 ASCOT experiment. Shinn, J. H. (Lawrence Livermore National Laboratory, Livermore, California (US)); Cederwall, R. T.; Gouveia, F. J.; Chapman, K. R. *Journal of Applied Meteorology (USA)*, 28(7): 569-577 (Jul 1989).

Micrometeorological data collected on towers are used to document slope flows on the sidewalls of main and tributary canyons. Six weeks of low-frequency, continuous data provide a background for comparison with data obtained during two nocturnal experiments. This comparison demonstrates the relatively strong drainage conditions during the experiments. The expected low-level wind speed maxima were observed, along with mass flux divergence down the 35° slopes. Profiles of turbulent kinetic energy, derived from high-frequency data taken during the two experiments, show a maximum near the canyon sidewalls. These features of the slope flows are disturbed occasionally on the main valley sidewall when the main valley flow impacts the sidewall; such disturbances are not observed in the tributary canyon.

43336 A numerical model study of nocturnal drainage flows with strong wind and temperature gradients. Yamada, T. (Los Alamos National Laboratory, Los Alamos, New Mexico (US)); Bunker, S. *Journal of Applied Meteorology (USA)*, 28(7): 545-554 (Jul 1989).

A second-moment turbulence-closure model described in Yamada and Bunker is used to simulate nocturnal drainage flows observed during the 1984 ASCOT field expedition in Brush Creek, Colorado. In order to simulate the observed strong wind directional shear and temperature gradients, two modifications are added to the model. The strong wind directional shear was maintained by introducing a "nudging" term in the equation of motion to guide the modeled winds in the layers above the ridge top toward the observed wind direction. The second modification was accomplished by reformulating the conservation equation for the potential temperature in such a way that only the deviation from the horizontally averaged value was prognostically computed.

43337 Tributary, valley and sidewall air flow interactions in a deep valley. Porch, W. M. (Los Alamos National Laboratory, Los Alamos, New Mexico (US)); Fritz, R. B.; Coulter, R. L.; Gudiksen, P. H. *Journal of Applied Meteorology (USA)*, 28(7): 578-589 (Jul 1989).

Field experiments measuring nocturnal tributary flows have shown complex internal structure. Variations in the flow range from short-term (8–16 min) oscillations (related to tributary/valley flow interactions) to long-term flow changes throughout the night (related to upper ridge slope and tributary sidewall cooling rate changes). The mean vertical structure in the tributary flow shows a three layer structure. Outflow winds are observed near the surface and in an elevated jet up to several hundred meters height. A flow minimum or counterflow exists at about the height of the drainage flow maximum in the main valley. Comparisons of flow volumes and variations from a single large tributary show that 5%–15% of the nocturnal flow in the main valley may be contributed through one tributary. This implies that tributaries may dominate main valley sidewall and midvalley subsidence contributions to valley drainage flows.

43338 Simulation of tracer concentration data in the Brush Creek Drainage flow using an integrated puff model. Rao, K. S. (Atmospheric Turbulence and Diffusion Division, NOAA/ARL, Oak Ridge, Tennessee (US)); Eckman, R. M.; Hosker, R. P., Jr. *Journal of Applied Meteorology (USA)*, 28(7): 609-616 (Jul 1989).

During the 1984 ASCOT field study in Brush Creek Valley, two perfluorocarbon tracers were released into the nocturnal drainage flow at two different heights. The resulting surface concentrations were sampled at 90 sites, and vertial concentration profiles at 11 sites. These detailed tracer measurements provide a valuable dataset for developing and testing models of pollutant transport and dispersion in valleys.

43339 The dispersion of atmospheric tracers in nocturnal drainage flows. Gudiksen, P. H. (Lawrence Livermore National Laboratory, Livermore, California (US)); Shearer, D. L. *Journal of Applied Meteorology (USA)*, 28(7): 602-608 (Jul 1989). DOE Contract W-7405-ENG-48.

This paper summarizes the results of a series of perfluorocarbon tracer experiments that were carried out in the Brush Creek Valley in western Colorado under the auspices of the Atmospheric Studies in Complex Terrain (ASCOT) program. The results indicate that tracers entrained within the valley's nocturnal drainage flows displayed well defined plumes that were not influenced significantly by the larger scale flows above this deep and narrow valley. Thus, the spatial distributions of the tracers were primarily governed by the structure of the drainage flows. None of the tracers released within the valley were detected in significant quantities on the adjoining meses or within the adjacent valleys prior to sunrise.

5002 Chemicals Monitoring and Transport

Refer also to citation(s) 41462, 41490, 41492, 41493, 41494, 41552, 41553, 41576, 41603, 41925, 42361, 42393, 42408, 42914, 43034, 43262, 43323, 43329, 43330, 43424, 43426, 43433, 43439, 43450, 43493, 43559, 43578, 43638, 43643, 43650, 43651, 43652, 43663

43340 (AD-A–206179/4/XAB) **Correlation between satellite-derived aerosol characteristics and oceanic dimethylsulfide (DMS). Master's thesis.** Shema, R.A. Naval Postgraduate School, Monterey, CA (USA). Dec 1988. 57p. Available from NTIS, PC A04/MF A01.

Original contains color plates: All DTIC and NTIS reproductions will be in black and white.

Since the turn of the century, the earth's climate has fluctuated between warming and cooling cycles. A warming cycle has been observed in the early 1900's. The rising global temperature has been attributed to CO_2 release from the burning of fossil fuels. The absorption of IR energy emitted from the earth, or greenhouse effect , brought concern that continued warming would melt polar ice caps and permanently change global climate. However, beginning in the mid-1940's, atmospheric cooling was observed. A possible contribution to the cooling trend is an increase in the numbers of relatively small aerosol particles. These particles are efficient scatters of solar radiation. An increase in the number of scattering events causes a higher albedo, thereby creating a cooler planet. McCormick and Ludwig (1967) have presented arguments to show

this relationship. Approximately forty years later, in the early 1980's, warming of the earth's climate again has been observed.

43341 (AD-A–206321/2/XAB) **RESOLVE (Research on Operations Limiting Visual extinction) project: visibility conditions and causes of visibility degradation in the Mojave Desert of California. Final report, 1983-1986.** Trijonis, J.; McGown, M.; Pitchford, M.; Blumenthal, D.; Roberts, P. Naval Weapons Center, China Lake, CA (USA). Jul 1988. 174p. (NWC-TP–6869). Available from NTIS, PC A08/MF A01.

See also Executive Summary, AD-A206 322.

The Department of Defense has been conducting an extensive air-quality study called RESOLVE(Research on Operations Limiting Visual Extinction).

43342 (AD-A–206322/0/XAB) **RESOLVE (Research on Operations Limiting Visual Extinction) project: visibility conditions and causes of visibility degradation in the mojave desert of California. Executive summary. Report for 1983-1986.** Trijonis, J.; McGown, M.; Pitchford, M.; Blumenthal, D.; Roberts, P. Naval Weapons Center, China Lake, CA (USA). Jul 1988. 11p. (NWC-TP–6869-SUMM). Available from NTIS, PC A03/MF A01.

Executive Summary to AD-A206 321.

The Department of Defense has been conducting an extensive air-quality study called RESOLVE (Research on Operations Limiting Visual Extinction).

43343 (BCMEP–8704) **Western and Northern Canada acid deposition/LRTAP activities annual report, 1986.** British Columbia Ministry of Environment and Parks, Victoria, BC (Canada). 1987. 57p. (MICROLOG–87-06131). Available from Western and Northern Canada acid deposition/LRTAP activities, 2nd. Fl., 4999-98th Ave., Edmonton, AB, CAN T6B 2X3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A committee was established in 1980 by senior officials of Environment Canada and the environment ministries of British Columbia, Alberta, Saskatchewan, and Manitoba to coordinate monitoring, research, and other activities related to acid rain and the long-range transport of atmospheric pollutants (LRTAP). By 1982 the Northwest Territories also participated. The year's activity reported in this document shows progress in Western and Northern Canada toward a strategy for sound management of acid deposition. Priorities since 1985 have included monitoring of sulfate deposition, developing environmental standards to protect vulnerable ecosystems, developing mathematical models of LRTAP, measuring dry deposition of sulfate, monitoring surface water quality, documenting environmental impacts of acid deposition, and reviewing emissions control technologies. Research and monitoring activities are presented for each province and the federal government, for jointly managed programs, and for industry and institutional programs. Also included are tables listing annual sulfate deposition at the various monitoring stations, and a glossary of acronyms and abbreviations. 1 fig., 5 tabs.

43344 (BCMEP–8706) **Source testing code for the measurement of emissions of total reduced sulphur compounds from stationary sources.** Keshvani, K.A. British Columbia Ministry of Environment and Parks, Victoria, BC (Canada). 1987. 88p. (MICROLOG–87-04907). Available from British Columbia Ministry of Environment and Parks, Parliament Bldgs., Victoria, BC, CAN V8V 1X4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This draft code presents six standard test methods that will permit accurate and reproducible measurement of emissions of total reduced sulfur (TRS) compounds from stationary sources when data are required under the British Columbia Waste Management Act. At the present time, these methods are considered to be reliable for measuring TRS comprised of four odoriferous sulfur compounds: hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide. Details are included for determination of sampling site and traverse points, stack gas velocity and volumetric flow rate, gas composition and molecular weight, moisture content of stack gas, TRS determination using grab sampling, and TRS determination using thermal oxidation. An appendix presents calibration procedures for S-type pitot tubes, dry gas meters and orifice meters. Relevant calculation methods are given throughout. 12 refs., 13 figs., 11 tabs.

43345 (BLP–8706) **Residential combustion spillage monitoring.** Buchan, Lawton, Parent Ltd., Ottawa, ON (Canada); SRO Engineering Ltd., Montreal, PQ (Canada). 1987. vp. (CE–02713). Available from Canada Mortgage and Housing Corporation, Annex Bldg., 628 Montreal Rd., Ottawa, ON, CAN K1A 0P7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Sixteen homes were continuously monitored to determine the frequency and duration of combustion product spillage from the furnaces and water heaters. In the houses which did show spillage activity, event-controlled sampling was used to determine levels of air contaminants attributable to the spillage. Additional testing of the sample houses included: air tightness testing, air change rate testing and forced spillage contaminant testing. 1 ref., 2 figs., 7 tabs.

43346 (CMHC–8703) **Monitoring combustion gas spillage frequency and duration in 20 problem prone houses. Final report.** Canada Mortgage and Housing Corp., Ottawa, ON (Canada). 1987. 30p. (CE–02729). Available from Canada Mortgage and Housing Corporation, Annex Bldg., 628 Montreal Rd., Ottawa, ON, CAN K1A 0P7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A research project was carried out for the purpose of determining the number of combustion gas spillage events, and the total duration of spillage, in 20 houses where pressure-induced spillage was thought to be occurring. Houses were selected in 4 regions of the country, and included 15 gas heated housed and 5 oil heated. The counters mounted on gas-fired appliances relied on a thermistor to detect hot gas spillage from the dilutioon air inlets. The number of events, and total event duration, were recorded on battery-operated mechanical counters. Oil-fired detectors were similarly designed, but used conventional smoke alarms mounted above the barometric damper, instead of thermistors, for sensing spillage. The frequency and duration of spillage showed a great deal of variation from house to house. Thirteen of the houses (68%) recorded at least one spillage event over the monitoring period. Three of these 13 experienced one event only. another three houses experienced frequent long-term backdrafting episodes, with 5 top 23 min average spill durations. It is highly likely that the longer-term spills occurred as a result of chimney backdrafting. Oil-fired appliances experienced short-term spillage of 14 to 36 typical of start-up problems. Flue dampers on 4 of the houses interfered with placement of the monitors and hampered data collection and interpretation. In two of these houses, spillage was seen to be occurring on a continuous basis by the technicians installing the monitors, and yet no data on spillage was recorded. More sophisticated monitors could solve this problem and give a better record of the spillage patterns. 1 ref., 6 figs., 6 tabs.

43347 (CPS–8702, pp. 43-52) **Adaptation and application of a dense gas dispersion model Degadis.** To, N.M. (Esso Resources Canada Ltd., Calgary, AB, Canada); Fitch, M.A.; Micek, C. Environnement Canada, Ottawa, ON (Canada). Conservation et Protection. 1987. (CONF-870295–: Technical seminar on chemical spills, Toronto (Canada), 9-12 Feb 1987; MICROLOG–87-01873). In *Proceedings [of the] 4th technical seminar on chemical spills.* Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A heavier than air gas (HTAG) dispersion model Degadis has been selected to be developed into an emergency response tool. The adaptation of the model to run on a personal comuputer was successful. The organization of Degadis for such a computer consists of two main programs: Dsetup and Dega. Dsetup is run interactively. The user specifies information about the environment such as wind speed, temperature, and atmospheric pressure; the modelling details such as initial gas mass; and gas composition and properties and other details of the physical description of the gas release. Dsetup formulates the user-supplied information into an input file for program Dega. Within Dega, the main program is

DEGA1 which calls up subroutines and functions to perform transient or steady state dispersion simulations. Benchmark applications of the problem, however, showed that it speed in some cases needs to be improved. Other possible improvements are recommended. With changes including improved diagnostics and graphics, this version of Degadis is expected to become an effective tool for use in emergency response situations. 4 refs., 1 tab.

43348 (CPS–8702, pp. 165-173) **Continued development of a heavy gas dispersion modelling system: COBRA III.** Alp, E. (Concord Scientific Corp., ON, Canada); Bourque, C.P.; Oliverio, M; Napier, D.H.; Matthias, C.H. Environnement Canada, Ottawa, ON (Canada). Conservation et Protection. 1987. (CONF-870295–: Technical seminar on chemical spills, Toronto (Canada), 9-12 Feb 1987; MICROLOG–87-01873). In *Proceedings [of the] 4th technical seminar on chemical spills.* Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Increased use of toxic or flammable liquefied gases in recent years as a source of energy or chemical feedstock by industry has pointed to the need for developing and maintaining practical and well-tested heavy gas dispersion models for estimating hazard zones for accidental releases of these chemicals. In response to these needs, the COBRA heavy-gas spill and dispersion model has been developed. The original model was designed primarily to simulate instantaneous or constant liquefied natural gas (LNG) spills on large bodies of water for application to marine-tanker accidents. Later versions of the model extended the original model to: four chemicals, time varying spill rates, spills on land, confined spills, and simultaneous liquid and gas releases. Several further enhancements were made the most notable one being incorporation of the ability to handle liquid droplets of the spilled heavy gas liquid (HGL) within the plume. This latter enhancement is essential for modelling releases of chemicals such as chlorine ammonia and propane from pressurized containers such as storage spheres, or rail or truck tankers. This paper describes the model characteristics and presents results of predictions of the maximum hazard zones for several different release scenarios. In general, it is seen that the models allowance for liquid mist increases the size of the hazard zone and allowing liquid water to remain in the plume as opposed to dropping it out also gives larger hazard zones. Both factors have a cooling effect on the plume. These results indicate the importance of the model's ability to handle liquid droplets within the gas cloud. Some comparisons with field data are also made.

43349 (CPS–8702, pp. 115-135) **Comparison of a heavy gas release model with field data.** Sahota, H. (Ministry of the Environment, Air Quality and Meteorology, Rexdale, ON, Canada); Misra,P.K. Environnement Canada, Ottawa, ON (Canada). Conservation et Protection. 1987. (CONF-870295–: Technical seminar on chemical spills, Toronto (Canada), 9-12 Feb 1987; MICROLOG–87-01873). In *Proceedings [of the] 4th technical seminar on chemical spills.* Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A simple box model for heavy gas dispersion is modified to include the effects of wind shear in the surface layer. Instead of the usual assumption that the heavy gas cloud moves instantaneously, initial acceleration of the cloud is also accounted for. The model is verified with data from Thorney Island Field Trials in Great Britain (1982-1984). The results indicate that the location of the cloud is predicted with more accuracy when the effects of wind shear and initial acceleration are accounted for. 9 refs., 9 figs.

43350 (DOE/ER/60227–5) **[Maintenance of a rural precipitation chemistry center at Whiteface Mountain]: Progress report.** State Univ. of New York, Albany, NY (USA). Atmospheric Sciences Research Center. [1989]. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-84ER60227. Order Number DE89016622/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

All objectives on the MAP3S protocols have been met. This includes sampling, laboratory procedures, along with supporting measurements at the summit or lodge: wind velocity, pressure, temperature, relative humidity and ozone. All blind tests and audits have been successfully passed. Data obtained from chart recordings and data loggers are routinely summarized into hourly values, and archived for use as projects need them. The same personnel and facilities were available and all required operations were performed allowing Whiteface to be an active NTN precipitation monitoring site. This was a proposal, first and most importantly, to continue our participation in MAP3S; and secondly, with the small balance of time available in this research proposal, to extend our cloud chemistry effort toward a better characterization of ion deposition to a high elevation ecosystem. Of paramount importance is an accurate assessment of the flux of water and ions as functions of inputs (cloud, rain, and dry in order of importance). Two small studies have been carried out to help understand the importance of the major inputs to the mountain. 13 refs., 1 fig., 4 tabs.

43351 (DOE/ER/60372–4) **Multi-dimensional aspects of recent climate change in North America: Progress report, 15 August 1988–1 April 1989.** Kukla, G.J.; Gavin, J.E.; Karl, T.R. Columbia Univ., Palisades, NY (USA). Lamont-Doherty Geological Observatory. Apr 1989. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER60372. Order Number DE89016462/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Our objectives are: to analyse time related changes in the properties and frequency of individual air masses over North America and to determine the degree to which the observed changes agree with the predictions of climate models testing the CO_2 impact. Climate models predict a substantial warming of the surface air temperature due to increased levels of atmospheric CO_2 and other trace gases. The effect of greenhouse gases on the longwave versus the short wave radiation is different and affects various air masses differently. Climate change results partly form the changed properties of individual air masses and partly from the changed frequency of air mass types. We are studying the changes of air mass characteristics and changed frequency over time paying particular attention to moisture dependent variables which can mask the CO_2 signal. 5 figs., 2 tabs.

43352 (DOE/ER/69010–1) **Photosynthetic acclimation to elevated CO_2: Project status report.** Cure, J.D. Duke Univ., Durham, NC (USA). Dept. of Botany. Jul 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER69010. Order Number DE89015965/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The objectives of the first year of this project were to install Sunbrella Lighting Systems into Phytotron 'C' chambers; to assemble a gas exchange system for measurement of photosynthetic parameters under controlled conditions; to work out methods of sample handling and measurement of protein, chorophyll, initial and activated RuBP Carboxylase activity and active site concentration; to begin studying the effects of light intensity on the photosynthetic acclimation of a fast-growing species to elevated CO_2.

43353 (GKYA–7224DD67) **Investigation of the indoor air quality, airtightness, and air infiltration rates of a statistically random sample of 78 houses in Winnipeg.** Yuill (G.K.) and Associates Ltd., Winnipeg, MB (Canada). 1987. vp. (CE–02702). Available from Canada Mortgage and Housing Corporation, Annex Bldg., 628 Montreal Rd., Ottawa, ON, CAN K1A 0P7; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An investigation of the indoor air quality, air tightness and air infiltration rates of a random sample of 78 houses in Winnipeg was conducted in the summer and fall of 1987. The objective of this projecct was to obtain results that were representative of the Winnipeg housing stock. Therefore, a three-level sampling procedure was adopted and every effort was made to obtain positive responses from homeowners of the houses selected by this procedure. Indoor air quality was determined by measuring the pollutant levels at three locations in the home. The pollutants measured were carbon dioxide, carbon monoxide, formaldehyde, radon, ozone and respirable suspended particulates. Air tightness was measured by the fan

depressurization method. Intentional openings which include chimneys, flues, intake and exhaust ports, floor drains and sumps were left open. The air exchange rate was measured using the tracer gas technique. Initial concentrations of approximately 50 parts per billion sulphur hexafluoride were established and the rate of decay was then measured over a period of one hour. this rate of decay was then used to calculate the rate of air infiltration. Indoor air quality was related to the usage of exhaust fans in the home. Each fan was described in detail and its frequency of use was recorded. The noise level of each fan was measured with a sound level meter. Noise levels at nine preferred frequencies were also measured. A homeowner survey report was used to record personal data about the occupants. Parts of the data collected in the present project have been included in two data summaries. An article about SF_6/air mixture samplers is given as an appendix to this report. 4 figs., 6 tabs.

43354 (LIS–87) **Immission measurements of chlorinated hydrocarbons. Sampling, analysis, results.** Kirschmer, P.; Gerlach, A. Landesanstalt fuer Immissionsschutz des Landes Nordrhein-Westfalen, Essen (Germany, F.R.). 1989. 31p. (In German). Order Number DE89911267/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01.

Most halogenated hydrocarbons present in the atmosphere stem from the use of chlorinated hydrocarbons. Evidence has been found that some of these substances are of natural origin. Some halogenated hydrocarbons have an impact on atmospheric balance altering or disrupting physical and chemical processes. Informations on the presence, spatial distribution and amounts of pollution by these substances are necessary for initiating air quality protection and pollutant reduction measures. In order to obtain these informations, suitable sampling and analytical methods are essential. The North-Rhine Westphalia State Agency of Air Pollution Control and Noise Abatement (LIS) developed and applies a measurement method for determining highly volatile halogenated hydrocarbons. A description of this method is presented. For sampling, the adsorbant Tenax TA is used. Up to eight samples can be drawn automatically with the sampling unit. For the components trichloromethane ($CHCl_3$), tetrachloromethane (CCl_4), 1,1,1-trichloroethane ($C_2H_3Cl_3$), trichloroethylene (C_2HCl_3), tetrachloroethylene (C_2Cl_4) monthly and annual averages were derived from a one-year measurement programm at the station Essen-LIS. The annual averages amounted to 0.23 $\mu g/m^3$ for trichloromethane, 1.06 $\mu g/m^3$ for tetrachloromethane, 2.54 $\mu g/m^3$ for 1,1,1-trichloroethane, 1.47 $\mu g/m^3$ for trichloroethylene and 3.10 $\mu g/m^3$ for tetrachloroethylene. Thermal desorption, dependence of blank value and calibration of the analytical procedure are discussed in detail. (orig.).

43355 (OE/ARB–082-87-AQM) **Technicca! and operating manual APIOS [acid precipitation in Ontario study] deposition monitoring program. 1st revised edition.** Bardswick, W.S. Ontario Ministry of the Environment, Toronto, ON (Canada). Air Resources Branch. 1987. 201p. (MICROLOG–87-06356). Available from Ontario. Ministry of the Environment. A.P.I.O.S. Coordination Office, 40 St. Clair Avenue West, 7th Floor, Toronto, ON, CAN M4V 1M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The atmospheric deposition program in the Acidic Precipitation in Ontario Study (APIOS) is part of ongoing research to determine the quantity, acidic concentrations, and impact of acid rain and snow, as well as dry particulate matter, falling in sensitive areas and other parts of the province. The program consists of two monitoring networks, a cumulative (28 day) and an event (daily) network. This manual has been prepared to document these networks' operating procedures in order to guide personnel in carrying out their respective duties and responsibilities. The objective of these procedures is to ensure that the reported data are complete, accurate, precise, and representative. Quality control and quality assurance procedures are included. Field operations are detailed for both precipitation and air sampling in the two networks, and for preventive maintenance and calibration of equipment. Sample reception and preparation, analytical methods, data base management, and document control are also described. 13 refs., 31 figs., 8 tabs.

43356 (OME/APIOS–005) **Acid precipitation in Ontario study, annual program report, 1986/1987.** Ontario Ministry of the Environment, Toronto, ON (Canada). Acid Precipitation in Ontario Study. 1987. V (MICROLOG–87-05279). Available from Coordination Office, 40 St. Clair Avenue West, 7th Floor, Toronto, ON, CAN M4V 1M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Acidic Precipitation in Ontario Study (APIOS) was established in 1979 to investigate the causes and effects of the long-range transport of air pollutants. The program is organized into seven work groups: emissions and atmospheric processes, aquatic effects, terrestrial effects, biogeochemical effects, legal initiatives, environmental management and economics, and communications. This report summarizes the year's activities of APIOS and includes synopses of the major projects of the various work groups. An extensive listing of APIOS-related technical reports and submissions, publications, and papers is also included.

43357 (OME/APIOS–1989E) **Summary and analysis of the second progress reports by Ontario's four major sources of sulphur dioxide.** Ontario Ministry of the Environment, Toronto, ON (Canada). Acid Precipitation in Ontario Study. [1989]. 21p. (MICROLOG–87-04686). Available from Ontario. Ministry of the Environment. A.P.I.O.S. Coordination Office, 40 St. Clair Avenue West, 7th Floor, Toronto, ON, CAN M4V 1M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Four corporate sources produce about 80% of the sulfur dioxide emissions in Ontario: Inco and Falconbridge smelters in Sudbury, Algoma Steel Corporation in Wawa, and the fossil-fuel power plants of Ontario Hydro. As part of Ontario's Countdown Acid Rain Program, these sources have been required to stage reductions in their emission levels in order to help reduce acid deposition. As part of the regulations of this program, the sources must present regular progress reports. Summaries of these reports and of the government's response to them are presented. The summaries include brief descriptions of sulfur dioxide reduction methodologies employed, incluuding a improved pyrrhotite rejection and smelting operations at Inco and Falconbridge, low sulfur dioxide emissions due to low production at Algoma Steel, and research and development. Emissions of the four sources were a total of 194 kilotonnes below the 1389 kilotonnes permitted in 1986. 3 tabs.

43358 (OME/APIOS–1989F) **Summary and analysis of the second progress reports by Ontario's four major sources of sulphur dioxide.** Ontario Ministry of the Environment, Toronto, ON (Canada). Acid Precipitation in Ontario Study. [1989]. 31p. (In French). (MICROLOG–87-04711). Available from Ontario. Ministry of the Environment. A.P.I.O.S. Coordination Office, 40 St. Clair Avenue West, 7th Floor, Toronto, ON, CAN M4V 1M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

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43359 (ORNL/FTR–3331) **[Forest modeling conference, Joensuu and Hyytiala, Finland, and visits to Suonenjoki and Saariselka, Finland, June 25–July 10, 1989]: Foreign trip report.** Luxmoore, R.J. Oak Ridge National Lab., TN (USA). 27 Jul 1989. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015371/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler participated in a forest modeling conference in Finland with a presentation of modeling investigations conducted at Oak Ridge National Laboratory and with summary comments given

during the closing session. He also led a group discussion of cooperative activities sponsored by the International Union of Forestry Research Organizations. Informal visits were made to two research facilities of the Finnish Forest Research Institute. Observations from the conference and on forestry in Finland are summarized with focus on the carbon dioxide and climate change issues.

43360 (PB–89-169858/XAB) **Annular denuder sampler for phase-distributed semivolatile organic chemicals.** Coutant, R.W.; Callahan, P.J.; Chuang, J.C. Battelle Columbus Div., OH (USA). Mar 1989. 109p. Available from NTIS, PC A06/MF A01.

A compact compound annular denuder, with a removal efficiency for volatile polynuclear aromatic hydrocarbons (PAH) of at least 90% at flow rates of up to 200 L/min, was designed for use with the PS-1 sampler. Laboratory tests of this denuder showed no detectable (< 10%) removal of ambient particulate matter larger than 0.1 micrometer mean diameter at flow rates of 100-200 L/min. The vapor-collection efficiency, as measured with naphthalene, was better than 95%, and the capacity for removal of approximately 180 micrograms of naphthalene was better than 90%. The field experiments consisted of three series: (1) outdoors during the winter; (2) indoors within a laboratory; and (3) outdoors during the summer. In these experiments a denuder difference approach was followed to monitor the phase distributions of 18 PAH. The results in general are consistent with previous work and extend the overall body of information on the phase distributions of PAH and their tendencies for artifact formation as a result of volatilization during sampling. Phase distributions for PAH were shown to be well represented by the Dubrinin-Radushkevich isotherm under both summer and winter conditions.

43361 (PB–89-169874/XAB) **Construction and testing of electrochemical NO_2 PSDs.** Findlay, M.W.; Stetter, J.R.; Yue, C. Transducer Research, Inc., Naperville, IL (USA). Mar 1989. 66p. Available from NTIS, PC A04/MF A01.

The monitoring of pollutant gases at sub-ppm and low-ppb levels is of primary concern in indoor air and non-industrial locations such as the home. The trend toward more airtight homes, which began during the energy crisis of the early 1970s, has caused concern among health experts about increased levels of indoor pollutants such as the sulfur and nitrogen oxides. It is the objective of this work to develop a personal exposure monitor (PEM), which will allow real-time monitoring of low concentrations of NO_2. The work focused upon improvement of the existing electrochemical technique so that it can be used at ppb levels.

43362 (PB–89-173215/XAB) **Atmospheric processes and effects on materials. Interim report May 88-Dec 88.** Bufalini, J.J.; Edney, E.O. Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Research and Exposure Assessment Lab. 1989. 22p. (EPA–600/D-89/001). Available from NTIS, PC A03/MF A01.

Effects expected from the depletion of stratospheric ozone by the presence of CFCs are summarized. The two areas considered by these two reports are materials damage and atmospheric processes. Increased UV can affect materials in the following ways: (1) corrosion of metals is expected to increase because of increased acid deposition; (2) stone deterioration is expected to increase again because of increased acid deposition; (3) dyes are expected to fade more quickly; (4) polymers are expected to breakdown more rapidly; and (5) paints will weather faster. In the area of atmospheric processes, increased UV is expected to: (1) increase photochemical reactions in cities and more ozone is expected; (2) sulfur dioxide is expected to oxidize to sulfate more quickly; and (3) gas-particle reaction rates are expected to increase.

43363 (PB–89-173223/XAB) **Historic emissions of VOC (volatile organic compounds) and NOx in the United States from 1900 to 1985. Report for June 1988-January 1989.** Gschwandtner, G.; Mobley, J.D. Pechan (E.H.) and Associates, Inc., Durham, NC (USA). 1989. 9p. Available from NTIS, PC A02/MF A01.

See also PB–88-208723.

This paper discusses historic emissions of volatile organic compounds (VOCs) and nitrogen oxides (NOx) in the U.S. from 1900 to 1985. Total VOC emissions have increased over the study period with peaks around 1930 and 1970. In 1900, transportation sources contributed 2% of the total emissions. By 1960, these sources contributed nearly 50% of the total VOC emissions. Also, the percentage contribution of industrial processes increased from about 3% in 1900 to 26% in 1960 and 39% in 1980. External fuel combustion was a major category from 1900 to 1940, but the percentage contribution has decreased since then. Similarly, the contribution by miscellaneous other sources has also decreased with time. The percentage contribution of solid-waste disposal appears to have remained nearly constant over time. NOx emissions have increased nearly steadily since 1900, while SO_2 emissions have gradually increased from 1900 to 1980 with considerable changes during certain shorter periods of time. VOCs have also increased, but the rate of increase appears to be less than that of NOx and more than SO_2, at least on the national level.

43364 (PB–89-174171/XAB) **Size-resolved real-time measurement of sulfate aerosols utilizing an aerosol concentrator.** Fitz, D. AeroVironment, Inc., Monrovia, CA (USA). Nov 1986. 22p. (AV-FR–86/597). Available from NTIS, PC A03/MF A01.

The objective of the project was to determine the feasibility of using an aerosol concentrator as a size-resolving device, the output of which would be directed to a real-time flame photometric sulfate analyzer. The size resolving ability of the concentrator was investigated by inputting a synthetic aerosol of latex beads of precisely known size and varying the operational parameters. Results indicate that the concentrator in its present form gives inadequate size-resolution as a function of rotational speed. However, operational parameters were discovered that allowed aerosol concentration invariant of particle size. Results also indicate that the instrument did not perform well as a size-selective device due to design features that may be easily remedied. So modified, the concentrator may still meet the original objectives. A concentrator could be a marketable instrument on its own for use in improving detection limits and shortening sampling time. This would be particularly useful for sampling aerosol from aircraft using filters and for real-time particulate analyzers, which are often on the borderline of being sufficiently sensitive.

43365 (PB–89-174742/XAB) **Air-monitoring survey design for toxic air pollutants. Final report.** Crowder, J.W.; DePaul, F.T.; Bowman, J.T. DePaul and Associates, Inc., Highland Park, IL (USA). Mar 1989. 150p. Available from NTIS, PC A07/MF A01.

An objective methodology for locating toxic air-pollutant sampling sites is presented. The first priority is given to determining sampling locations where maximum concentrations could be measured. Because of the high cost of ambient measurements for most toxic pollutants, emphasis is placed on identifying locations that not only have high expected concentrations, but also a statistically significant frequency of occurrence, so that there is a good potential of seeing these values with an intermittent sampling schedule. The second priority is given to locating sites whose information could aid in finding unknown or poorly quantified sources and a technique is presented for analyzing data from the network of samplers. The siting methodology and data analysis techniques are illustrated using the southeast area of Chicago.

43366 (PB–89-180483/XAB) **Assessment of national and regional acid deposition precursor emission trends. Report for October 1986-March 1987 (Final).** Wilson, J.H.; Pechan, E.H.; Graves, K. Pechan (E.H.) and Associates, Inc., Springfield, VA (USA). Mar 1989. 136p. Available from NTIS, PC A07/MF A01.

This report gives results of an analysis of national and regional acid deposition precursor emission trends, involving SOx, NOx, and VOCs. While the focus is on emissions during 1980-1985, comparisons are made (for perspective) with emission trends for 1940-1980. Study methods integrated data from the U.S. EPA's national emission trends reports, state and regional activity indicators, and plant-level data for electric utilities and copper smelters. For 1980-1985, all three pollutants showed both annual declines and increases. For a longer term, emission trends can be divided into three periods: (1) 1940 to the mid-1970s, when emissions increased in proportion to fuel use and the GNP; (2) the late 1970s to the early 1980s, the emissions control era, when Clean Air Act programs produced a downward trend for all pollutants except NOx as the economy continued growing; and (3) since 1980, when relationships between emissions and the economy, fuel use, and regulations are making it more difficult to predict emissions in future years.

43367 (PB–89-181101/XAB) **Receptor model technical series, Volume 3 (revised). CMB (Chemical Mass Balance) model user's manual (version 6.0).** Axetell, K.; Watson, J.G. PEI Associates, Inc., Durham, NC (USA). May 1987. 84p. (EPA–450/4-83/014R). Available from NTIS, PC A05/MF A01.

For system on diskette, see PB–89-181093. See also PB–83-264622, and PB–87-206496.

The Chemical Mass Balance (CMB) Model uses the chemical composition of an ambient particulate sample to estimate the relative contributions of different source categories to the measured particulate concentration. The manual describes Version 6.0 of the CMB Receptor Model. It is designed to allow persons to use the CMB Model constructively with only a few hours learning time. The manual covers primarily the mechanical aspects of running the model. The manual is intended for wide use by state and local air pollution control agency personnel in developing State Implementation Plans (SIPs) for PM(10).

43368 (PB–89-181275/XAB) **Technological progress in reducing CFC (chlorofluorocarbon) and halon emissions.** Smith, N.D.; Shapiro, P.S. Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab. Apr 1989. 13p. (EPA–600/D-89/074). Available from NTIS, PC A03/MF A01.

This paper discusses EPA's development of a technological program to implement in the U.S. the Montreal Protocol on Substances that Deplete the Ozone Layer. EPA's Office of Air and Radiation (OAR) has the lead for developing the technical and economic goals of the program, and EPA's Office of Research and Development (ORD) has the lead in providing technical support to meet the goals, including both short-term projects and long-term research. EPA's strategy is to target the halon and high chlorofluorocarbon (CFC)-using industries or industry subgroups to identify opportunities to reduce CFC and halon usage and find alternatives. When such opportunities are found, cooperative industry/government groups are formed to identify and solve the problems that impede transition away from CFC and halon usage. Other groups (including academic, non-profit research institutes, other government agencies, and foreign individuals or groups) are invited to join in the effort if they have a special expertise or interest. Identifying the high-use industry sectors and subsectors is not difficult; however, identifying appropriate industries, individuals, and groups who are willing to influence industry usage of CFCs is not easy.

43369 (PB–89-181291/XAB) **Area sources of VOC (volatile organic compounds) emissions and their contribution to tropospheric ozone concentrations. Report for July 1988-March 1989.** Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab. 1989. 19p. (EPA–600/D-89/075). Available from NTIS, PC A03/MF A01.

The paper quantifies the importance of area sources to total volatile organic compound (VOC) emissions, reviews components of EPA/AEERL's non-attainment program, discusses the status of emission control or prevention for several area sources, and reviews some of the regulatory strategies being implemented or considered by state and local air pollution agencies. In 1988, several projects were undertaken by AEERL to develop a greater understanding of the contribution to the ozone problem by area sources of VOCs. These include studies related to specific sources of VOCs, identification of consumer/commercial product control options, and determination of the regional/seasonal variations in emissions. In each study, available sources of information have been used to develop priorities for the sources of emissions contributing to the ozone non-attainment problem. Sources of data include the technical literature, contacts in industry and elsewhere in the EPA, and surveys conducted by various trade organizations.

43370 (PB–89-181341/XAB) **Sampling of reactive atmospheric species by transition-flow reactor: application to nitrogen species (journal version).** Ellestad, T.G.; Knapp, K.T. Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab. 1988. 9p. (EPA–600/J-88/217). Available from NTIS, PC A02/MF A01.

Pub. in Atmospheric Environment, Vol. 22, No. 8, 1595-1600(1988).

Concentrations of nitric acid vapor and fine particulate nitrate were measured at the 1985 Nitrogen Species Methods Comparison Study at Claremont, California with a transition-flow reactor, which separates the gases and particles by differential diffusion in a transition-flow stream and avoids sampling artifacts for these reactive species.

43371 (PB–89-181374/XAB) **Supplement to the 1986 EPA (Environmental Protection Agency) air-quality criteria for lead - Volume 1, addendum (pages A1-A67). Draft report.** Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Criteria and Assessment Office. Mar 1989. 87p. (EPA–600/8-89/049A). Available from NTIS, PC A05/MF A01.

See also PB–87-142386.

The 1986 U.S. EPA document Air Quality Criteria for Lead (EPA-600/8-83/028 aF-dF) evaluated in detail the latest scientific information concerning sources, routes, and levels of lead (Pb) exposure and associated health effects and potential risks. An Addendum (1986) to that document focuses on additional, newer studies concerning the effects of lead on cardiovascular function and on early physical and neurobehavioral development. The present Supplement to the above materials evaluates further still newer information emerging in the published literature concerning (1) lead effects on blood pressure and other cardiovascular endpoints and (2) the effects of lead exposure during pregnancy or early postnatally on birth outcomes and/or the neonatal physical and neuropsychological development of affected children. The evaluations contained in the Supplement and the 1986 Criteria Document and Addendum are to serve as scientific inputs to decisionmaking with regard to review and revision, as appropriate, of the National Ambient Air Quality Standards (NAAQS) for Lead.

43372 (PB–89-181424/XAB) **User's guide to the Complex-Terrain Dispersion Model Plus Algorithms for Unstable Situations (CTDMPLUS): Volume 1. Model description and user instructions.** Perry, S.G.; Burns, D.J.; Adams, L.H.; Paine, R.J.; Strimaitis, D.G. Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Research and Exposure Assessment Lab. Mar 1989. 211p. Available from NTIS, PC A10/MF A01.

The Complex Terrain Dispersion Model Plus Algorithms for Unstable Situations (CTDMPLUS) is a refined air-quality model for use in all stability conditions for complex-terrain applications. It contains the technology of the original Complex Terrain Dispersion Model (CTDM) for stable and neutral conditions, but also models daytime, unstable conditions. The model makes use of considerable detail in the terrain and meteorological data (as compared to current EPA regulatory models) and requires the parameterization of individual terrain features, thus considering the three-dimensional nature of the interaction of the plume and terrain. The user's manual describes, in detail, the basis of the model and instructions for its use.

43373 (PB–89-181440/XAB) **Health-hazard evaluation determination report No. 77-37-413, Gates Rubber Company, Denver, Colorado.** Gunter, B.J. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Aug 1977. 12p. (HHE–77-037-413). Available from NTIS, PC A03/MF A01.

Personal air-sampling and employee interviews were conducted on February 9, 1977 and March 1, 1977 to evaluate worker exposures to zinc oxide, resorcinol, formaldehyde, sodium hydroxide, and ammonia during the manufacture of high pressure hose at the Gates Rubber Company in Denver, Colorado. One of ten sodium hydroxide samples exceeded the threshold limit value of 2 milligrams per cubic meter. Zinc oxide, formaldehyde, ammonia and resorcinol samples were all below evaluation criteria. The author concludes that a health hazard existed from a combination of low exposures to zinc oxide, resorcinol, formaldehyde, ammonia and rayon fibers as well as from exposure to sodium hydroxide. The author recommends that ventilation be installed in the braided hose department, that employees be provided with barrier creams for protection, and that physicians treating the employees be informed of worker exposures and work conditions.

43374 (PB–89-181457/XAB) **Health-hazard evaluation determination report No. 76-31-338, Becton-Dickinson, Division of Becton-Dickinson and Company, Juncos, Puerto Rico.** Rivera, R.; Harrington, M. National Inst. for Occupational Safety and Health,

Cincinnati, OH (USA). Oct 1976. 19p. (HHE–76-031-338). Available from NTIS, PC A03/MF A01.

Environmental and medical surveys were conducted on February 18-20, 1976 to investigate reports of mercury poisoning in workers at the Becton-Dickinson Thermometer Factory in Juncos, Puerto Rico. Breathing-zone mercury concentrations ranged up to 0.419 milligrams per cubic meter (mg/CuM), exceeding the OSHA standard of 0.l mg/CuM. Mercury concentrations in blood samples ranged from 4.0 to 39.9 nanograms per milliliter (ng/ml), and exceeded the maximum allowable concentration (MAC) of 35 ng/ml in one case. Mercury concentrations in the urine samples ranged from 10 to 120 ng/ml, which were below the equivalent MAC of 150 ng/ml. Eight cases of clinical mercurialism were diagnosed. The authors conclude that production workers are exposed to potentially toxic concentrations of mercury vapor. They recommend that work stations be vacuumed more frequently, that the company's surveillance procedures be reappraised, that protective clothing be provided and changed daily, that instructional programs be intensified to enhance employee awareness of the hazards of working with mercury, and that any exposure to mercury be minimized in women of reproductive age.

43375 (PB–89-181465/XAB) **Health-hazard evaluation determination report No. 75-150-378, Reinell Boats, Inc., Poplar Bluff, Missouri.** Rosensteel, R.E.; Meyer, C.R. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Apr 1977. 55p. (HHE–75-150-378). Available from NTIS, PC A04/MF A01.

A health-hazard investigation consisting of a combined environmental-medical study encompassing an initial survey and two follow-up evaluations was conducted at the Reinell Boats Plant, Poplar Bluff, Missouri, a facility engaged in the manufacture of fiberglass boats, between November 1975 and April 1976. Workers were evaluated through questionnaires and physical examination. Environmental assessment was accomplished by measuring airborne exposures to organic vapors, methylene bisphenyl isocyanate, and compounds containing cobalt; observing work practices; and evaluating spray-booth ventilation. In the lamination areas, the workers were primarily exposed to styrene, with less significant exposure to acetone and methylene chloride. A toxic exposure to workers was identified in the lamination areas, manifested by a marked increase of upper respiratory irritation symptoms. There was also evidence of dermatitis related to direct contact with solvents in lamination workers. Recommendations are made for medical and environmental control of conditions at this plant.

43376 (PB–89-181473/XAB) **Health-hazard evaluation determination report No. 75-11-403, Port of Duluth-Superior Grain Elevators, Duluth, Minnesota and Superior, Wisconsin.** Flesch, J.P.; Thoburn, T.W. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Jun 1977. 48p. (HHE–75-011-403). Available from NTIS, PC A03/MF A01.

A health hazard investigation was conducted by NIOSH at the grain elevators in the Port of Duluth-Superior in 1975-1976. Elevator breathing-zone exposures to chemical fumigants were nearly nonexistent; only traces of carbon tetrachloride were detected at five of the elevators surveyed. Some elevator workers were exposed to airborne total grain dust at levels exceeding the OSHA nuisance dust standards. Symptoms of eye irritation were reported by a few workers presumably due to excessive dust exposures during the survey. Extensive medical evaluation of the 307 exposed workers led to the conclusion that the working environment in the grain elevators has caused acute respiratory, eye, and nasal symptoms as determined by history from workers and personal observation. A high frequency of skin reactivity to intradermal injection of insect and flax antigen was found among workers; significant correlation with wheezing upon exposure to grain dust and respiratory function abnormalities were also found. Recommendations are made to provide for worker protection, surveillance, and health maintenance.

43377 (PB–89-181507/XAB) **Health-hazard evaluation determination report No. 77-15-421, Leeds and Northrup Corporation Expendable Devices Division, Ellwood City, Pennsylvania.** Kominsky, J.R.; Stroman, R.E. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Sep 1977. 27p. (HHE–77-015-421). Available from NTIS, PC A03/MF A01.

A health hazard evaluation was conducted on December 13-15 at the Leeds & Northrup Corporation, Expendable Devices Division, Ellwood City, Pennsylvania, a facility engaged in the manufacture of carbon analysis and temperature determination devices. The airborne concentrations of formaldehyde (50000) and ammonia (7429905) were low enough to prevent respiratory injury but not the subjective upper eye and respiratory irritation reported by some of the workers. Workers involved in cement mixing presented dermatitis which could be minimized by use of protective equipment and other measures. The operator of a large mixer was exposed to potentially toxic levels of respirable crystalline silica (7631869). Recommendations are made for measures that can help minimize dermal and respiratory effects apparent to the manufacturing processes evaluated.

43378 (PB–89-181515/XAB) **Health-hazard evaluation determination report No. 77-68-417, the Washington Post Company, Washington, DC.** Moseley, C.L. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Aug 1977. 16p. (HHE–77-068-417). Available from NTIS, PC A03/MF A01.

Environmental and medical surveys were conducted on April 25 and 26, 1977 to evaluate employee exposures to burning oil at the Washington Post Company (SIC-2711) in Washington, D.C. Environmental samples of lead, tin, antimony, oil mist, and associated vapors indicated that worker exposures were not in excess of the recommended criteria. Some workers experienced irritation when exposed to smoke and vapors generated by the casting operation. The author concludes that the physiological stresses reported by the subject workers may be due to individual susceptibility. The author recommends that the workers experiencing discomfort leave the room during periods of greater contaminant generation, that the pedestal fan be moved to a more effective position, that all persons assisting in or observing the operation of shop equipment wear protective shields or glasses, that a safer practice be adopted for cleaning lead residues, and that the casting room be isolated from the rest of the work area.

43379 (PB–89-181788/XAB) **Cloud and precipitation scavenging process in the South Coast Air Basin. Final report.** Hegg, D.A.; Hobbs, P.V. Washington Univ., Seattle, WA (USA). Dept. of Atmospheric Sciences. 8 Nov 1988. 149p. Available from NTIS, PC A07/MF A01.

This report presents the results of airborne aerometric measurements of particles and trace gases during the Southern California Air Quality Study (SCAQS). Nine flights were made on six of the SCAQS study days during June and July 1987. Samples were collected at four sites per flight for measurement of sulfur dioxide, nitric acid, PAN, ammonia, fine particle (ionic species, metals, and elemental and organic carbon), carbonyl, and non-methane hydrocarbon concentrations. Analysis of the samples were performed by other SCAQS contractors. In addition, ancillary meteorological, and continuous ozone, nitrous oxide, nitrogen dioxide, sulfur dioxide, and light scattering measurements were obtained. Cloud samples were also collected when present. Measured atmospheric particle-size distributions are also presented.

43380 (PB–89-182067/XAB) **Health-hazard evaluation determination report No. 77-22-409, Purex Corporation, London, Ohio.** Gilles, D.; Meyer, C. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Aug 1977. 19p. (HHE–77-022-409). Available from NTIS, PC A03/MF A01.

See also PB–88-224274.

Environmental and medical surveys were conducted on December 8, 1976 and February 14-15, 1977 to evaluate employee exposure to soap dust from soap-impregnated steel wool pads at the Purex Corporation in London, Ohio. All respirable-dust samples were below the ACGIH standard for nuisance dust of 5 milligrams per cubic meter (mg/CuM). Three of the 75 total soap-dust concentrations exceeded the ACGIH standard of 10 mg/CuM for total nuisance dust. The soap dust, when added to pH 7 water, raised the solution pH to 10.5, which was moderately to severely alkaline. Some of the workers had abnormal pulmonary function-test results. Due to the presence of pulmonary function changes among some exposed workers, the high incidence of upper respiratory symptomatology and the high alkalinity of the soap dust, this dust should be categorized as more than a nuisance dust. Recommendations

are: the exposure limits be reduced; the ventilation system be expanded and operated at all times; employees be provided with appropriate respirators and instructions on their proper use; proper work procedures and handling methods be presented to all employees; a vacuum system be used for cleanup; and a medical-surveillance program be instituted.

43381 (PB–89-182729/XAB) **Acid deposition in Maryland: summary of results through 1988. Annual report.** Maryland Power Plant Research Program, Annapolis, MD (USA). Jan 1989. 166p. (PPRP/AD–89-1). Available from NTIS, PC A08/MF A01.

See also PB–88-157805.

The Chesapeake Bay Research and Monitoring Program coordinates Maryland's acid-deposition research and reports research results annually. This report evaluates several major topic areas including transport and chemistry of acid deposition its potential impacts on the State's streams and fish, possible impacts on terrestrial resources such as crops and forests and on materials, the ability of energy conservation programs to reduce emissions of acid-forming pollutants, and mitigation techniques for neutralizing acid waters.

43382 (PB–89-184584/XAB) **Glossary of terms related to health, exposure, and risk assessment.** Environmental Protection Agency, Research Triangle Park, NC (USA). Air Risk Information Support Center. Mar 1989. 43p. (EPA–450/3-88/016). Available from NTIS, PC A03/MF A01.

Also available from Supt. of Docs.

Many state and local agencies are developing or implementing programs to control emissions of toxic air pollutants. To successfully carry out these programs, agency personnel must be familiar with a wide range of issues and terms related to health, exposure, and risk assessment for toxic air pollutants. Understanding these issues and terms is not always an easy task. This glossary was prepared by the U.S. EPA's Air Risk Information Support Center (Air RISC) as a resource tool for State and local air pollution control agencies and U.S. EPA Regional Offices. The purpose of the glossary is to define terms that are commonly used in health, exposure, and risk assessments for toxic air pollutants.

43383 (PB–89-184709/XAB) **National air-pollutant emission estimates, 1940-1987. Final report.** Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards. Mar 1989. 83p. (EPA–450/4-88/022). Available from NTIS, PC A05/MF A01.

See also PB–88-169388.

This report presents estimates of trends in nationwide air-pollutant emissions for six major pollutants: sulfur oxides, particulate matter with PM/TSP as the indicator pollutant, carbon monoxide, reactive volatile organic compounds, nitrogen oxides, and lead. Estimates are provided for major categories of air-pollution sources. A short analysis of emission trends is given, along with a discussion of methods used to develop the data.

43384 (PB–89-186605/XAB) **Industrial-hygiene survey report of Delta Air Lines, Inc. Technical Operations Center, Hartsfield Atlanta International Airport.** Piacitelli, G.; Krishnan, R. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). 18 Jan 1989. 23p. (IWS–134.20.12). Available from NTIS, PC A03/MF A01.

A visit was made to the technical operations center of Delta Air Lines, Atlanta, Georgia to evaluate worker exposure, personal protective equipment and engineering controls in work areas where ethylene glycol ethers were used. At this facility the potential for inhalation and dermal exposure to the ethers exists primarily in the hangers during spray coating of the aircraft, small parts and ground support equipment. Approximately 20 male workers were potentially exposed directly during painting operations; approximately 50 to 60 workers working in adjacent areas may have been indirectly exposed. Concentrations of 2-ethoxyethyl-acetate (2-EEA) ranged from 0.29 to 2.77 parts per million (ppm); the OSHA permissible exposure limit was 100 ppm, and the NIOSH recommended exposure limit was the lowest feasible level. The actual inhaled dose would be much lower as a result of the use of personal protective equipment during painting operations. A potential for exposure to 2-EEA was also noted during the mixing of the paints and after the painting was completed. Protective equipment was not normally used at these times. The authors recommend specific efforts to minimize exposures.

43385 (PB–89-186662/XAB) **Industrial-hygiene survey report of Pan American Tannery, Gloverville, New York.** Fajen, J.M.; Calvert, G. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Jan 1989. 37p. (IWS–076.13). Available from NTIS, PC A03/MF A01.

As part of a larger study concerning the clustering of testicular cancer among finish-department employees in tanneries, a visit was made to the Pan American Tannery, Gloverville, New York. Area air samples were taken for dimethylformamide, glycol ethers, and substances in the general air. Bulk samples were also obtained to determine the potential for exposure to heavy metals. Major components in the air samples were identified as butyl-cellosolve, diisobutylketone, limonene, and 2-ethylhexyl-acetate. Dimethylformamide was not found in the air and was no longer used in the facility. Lead was found in concentrations as high as 22,400 parts per million in a bulk scraping from a ventilation duct. The high concentrations of lead result from lead based pigments. There were three cases of testicular cancer in finishing department employees, representing a crude standardized incidence ratio of 40.5. Area air samples indicate that exposure to glycol ethers did not exceed the Federal recommended limits. The authors recommend that an ongoing testicular cancer surveillance program be provided for past and present male employees in the finishing department. Improvements should be made in the personal protective equipment offered to the workers and strict controls be instituted regarding lead exposures.

43386 (PB–89-186670/XAB) **Health-hazard evaluation report HETA-88-335-1940, Fort Stanwix National Monument, Rome, New York.** McManus, K.P. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Dec 1988. 10p. (HETA–88-335-1940). Available from NTIS, PC A02/MF A01.

See also PB–85-101343.

In response to a request from the National Park Service, an evaluation was made of possible hazardous conditions at Fort Stanwix National Monument, Rome, New York. Employee complaints had been received concerning odors and ventilation-system malfunctions. The facility was a replica of a Civil War era log building; the ductwork and air handlers for the ventilation system were located underground in a tunnel system. Indoor air quality was monitored. Dew point measurements indicated that for all areas it was between 55 and 60 deg F. Temperatures ranged from 71 to 75 deg F and humidity between 60 and 65%. Measurements of carbon dioxide registered 400 parts per million in the office and visitor center, indicating a sufficient fresh air supply to these areas. The design of the ventilation system allowed make up air to be drawn from the tunnel area. The author concludes that indoor air quality was acceptable according to evaluation criteria. The author recommends that the fresh air, which may be ducted directly to the outside air; this may eliminate complaints of musty odors.

43387 (PB–89-186688/XAB) **Health-hazard evaluation report HETA-88-311-0000, Office of Disability Determination, The Howard Building, Tampa, Florida.** Roper, P.; Lushniak, B. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Jan 1989. 17p. (HETA–88-311-0000). Available from NTIS, PC A03/MF A01.

In response to a request from the Area Manager of the Office of Disability Determination, an evaluation was made of possible hazardous working conditions at the Howard Building, Tampa, Florida. Particular concern was voiced with regard to eye irritation, headaches, and fatigue with a possible connection to water leakage into the offices and pigeon nesting areas above suspended ceilings. Studies indicated no carbon-monoxide, nitrogen-dioxide, or formaldehyde concentration in the building. Carbon dioxide levels of 1000 parts per million or above were recorded which were indicative of inadequate air exchange between a building and the outdoors. An area was found along the south wall of the building with gross contamination by bird droppings and other debris. Rainwater leakage above the areas where the birds had nested washed the excrement and debris down over the office walls. As much as 2 inches of bird droppings were found on some suspended tiles. The crawl space above the first floor was observed to have health and safety hazards. Some of the symptoms were likely allergic rhinitis

while others may have resulted from a lack of fresh outdoor air. Specific measures should be taken to safely remove the bird debris, prevent additional bird inhabitation, improve drainage of condensate water, and provide an outdoor air-supply system.

43388 (PB–89-186696/XAB) **Health-hazard evaluation report HETA-88-287-1942, Saint Mary-Corwin Hospital, Pueblo, Colorado.** Gunter, B.; Daniels, W. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Dec 1988. 24p. (HETA–88-287-1942). Available from NTIS, PC A03/MF A01.

In response to a request from Saint Mary-Corwin Hospital Pueblo, Colorado, an evaluation was made of possible hazardous working conditions. Concern centered around waste anesthetic gases and vapors in the main operating rooms, exposure to ethylene oxide (EtO) from a gas sterilizer, and exposure to solvents used in the laboratory. Personal breathing zone samples were analyzed for nitrous-oxide (N_2O), halogenated anesthetic agents, xylene (1330207), EtO, acetone, and benzene. The authors conclude that there were no exposures above the environmental criteria during the survey. The authors recommend specific measures including control procedures, work practices, and work procedures that would reduce employee exposures in the operation rooms.

43389 (PB–89-187165/XAB) **Derivation of formic acid data from FT-IR spectra recorded during the 1986 carbonaceous species methods comparison study. Final report.** Tuazon, E.C. California Univ., Riverside, CA (USA). Statewide Air Pollution Research Center. Feb 1989. 20p. Available from NTIS, PC A03/MF A01.

Formic acid (HCOOH) concentrations were derived from long-path FT-IR spectra which were recorded during the Carbonaceous Species Methods Comparison Study held in Glendora, CA, August 12-21, 1986. Both the detailed instantaneous and the hourly average HCOOH values are presented here. HCOOH concentrations during the study were in the range 1-11 parts per billion (ppb). The detection sensitivity was 1 ppb and the measurement errors were within + or - 1.5 ppb. During the first 5-6 days of the study, the HCOOH concentration profiles were generally coincident with photochemical activity. During the remaining days, HCOOH levels were found to be highest in the very early morning hours, presumably as a result of build-up from as yet undetermined primary sources.

43390 (PB–89-187959/XAB) **Construction and testing of a vapor sensor based on ion mobility and gas flow.** Smith, J.P. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Nov 1988. 37p. Available from NTIS, PC A03/MF A01.

In order to answer the need for low-cost gas monitors for use in gas detection applications, a prototype sensor was built on the principle of ion mobility, and the performance of this prototype was evaluated. Ion mobility employed the difference in drift velocity in an electric field of ions formed from different substances. Due to its sensitivity, ion mobility has been used for the monitoring of a number of kinds of pollutants in air for a number of years. The technique was simple as separation of different ions depended on the difference in their drift velocities in air at atmospheric pressure. The ions were measured from the substance of interest at a narrow collector after they had traveled in a vertical direction under the influence of an electric field and in a perpendicular direction using air flow. It was anticipated that ions of different mobilities could be separated in this manner. The sensor functioned as predicted in a qualitative sense. At a given flow rate, response from the device was obtained over a given range of voltages, determined by the flow rate used. The device was very sensitive to flow parameters.

43391 (PB–89-187991/XAB) **Health-hazard evaluation report mHETAs-87-110-1943, Columbia Farms Poultry Plant, Columbia, South Carolina.** Ferguson, R. National Inst. for Occupational Safety and Health, Morgantown, WV (USA). Jan 1989. 28p. (MHETA–87-110-1943). Available from NTIS, PC A03/MF A01.

In response to a request from the U.S. Department of Agriculture, a study was made of possible hazardous working conditions at the Columbia Farms (SIC-2016) poultry processing center, West Columbia, South Carolina. Over 100,000 chickens were processed per day at the facility. The facility was located adjacent to the West Columbia water treatment site and was first on the water line to receive water from the site. In April of 1986 a change was made in the form of water treatment from chloration to chloramination for cost effectiveness, more stable water treatment, and lower trihalomethane levels in finished water. Workers in the inspection area experienced eye, nose, and throat irritation which was traced to uncombined ammonia and chloramines in the water at the processing facility. Concentrations of these chemicals in the water were quite variable. The author concludes that the symptoms in the workers may have resulted from high levels of ammonia and chloramines on some days. The author recommends that the water-treatment facility change from post ammoniation to pre ammoniation, or that the food-processing facility should explore the possibility of another source of water or treatment of the incoming water to remove the chloramines.

43392 (PB–89-188015/XAB) **Health-hazard evaluation report No. HETA-88-054-1936, US Customs Service, Washington, DC.** Reh, C.M. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Nov 1988. 21p. (HETA–88-054-1936). Available from NTIS, PC A03/MF A01.

An investigation was made of possible hazardous working conditions at the headquarters of the U.S. Customs Service, Washington, D.C. An electrical transformer located in the headquarters building leaked about 30 gallons of a cooling oil known to contain polychlorinated biphenyls (PCBs) in the fall of 1987. Air and surface sampling was performed in and around room B100 where the transformer vault was located. Area air sampling found no detectable levels of PCBs in the vault, in other areas of the room, in an adjacent office and projection room, or in the hallway. Surfaces within the room, including the vault, were heavily contaminated with PCBs with surface concentrations ranging from 3720 to 148,000 micrograms per square meter (microg/sq m). The basement hallway had surface concentrations of 224, 234, and 321microg/sq m. Surface sampling in a nearby office room showed PCB levels to be well below the recognized background concentration. There was a potential health hazard from PCB surface contamination in Room B100. Levels in adjacent areas were above background levels. Specific cleanup recommendations are made.

43393 (PB–89-188064/XAB) **Health-hazard evaluation report No. HETA-88-258-1941, University Hospital, Denver, Colorado.** Gunter, B.; Daniels, W. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Dec 1988. 17p. (HETA–88-258-1941). Available from NTIS, PC A03/MF A01.

In response to a request from the University Hospital, Denver, Colorado, an evaluation was made of possible hazardous working conditions at this site. Particular attention was given to waste anesthetic gases and vapors in the surgical operating rooms and in the recovery room. In 19 personal samples the time weighted average concentrations of nitrous oxide (N_20) ranged from less than the limit of detection to 77 parts per million (ppm) with a mean concentration of 17 ppm. The NIOSH recommended limit of 25 ppm was exceeded in five of 19 samples. Personal breathing samples were collected and sampled for halothane, ethrane, and isoflurane. Halothane was detected in seven of 24 samples ranging from 0.09 to 1.6 ppm. The NIOSH recommended limit for halothane of 0.5 ppm was exceeded in three samples. Ethrane was detected in five samples at 0.06 to 1.5 ppm concentration levels, with two exceeding the NIOSH limit of 0.5 ppm. Isoflurane was detected in six samples, ranging from 0.06 to 0.99 ppm, with three samples exceeding the NIOSH limit of 0.5 ppm. The authors conclude that a hazard existed from exposure to anesthetic gases and vapors during some of the procedures. Detailed recommendations regarding specific control procedures, work practices, and monitoring procedures were made.

43394 (PB–89-188080/XAB) **Health-hazard evaluation report No. HETA-88-166-1944, Hoeganaes Magnetic Materials, Rancocas, New Jersey.** Hales, T.R.; Burr, G.A. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Jan 1989. 20p. (HETA–88-166-1944). Available from NTIS, PC A03/MF A01.

An evaluation was undertaken of possible hazardous working conditions at Hoeganaes Magnetic Materials, Rancocas, New Jersey. Dermatitis and gastrointestinal problems were cited in the request. Magnets were produced at the site which contain the pyrophoric rare earth metals dysprosium and neodymium along with other materials. Personal breathing zone and general area air samples were taken for trace metals. Concentrations of iron oxide

ranged from 0.05 to 9.5 mg/cu m. Neodymium concentrations ranged from 0.0 to 5.0 mg/cu m with the highest levels occurring in the powder processing room where the magnetic powders were crushed, blended and milled. Concentrations of dysprosium ranged from 0.002 to 0.53 mg/cu m. Concentrations of thallium ranged from 0.02 to 0.16 mg/cu m. Lead was detected in two samples at 0.002 to 0.013 mg/cu m. The authors conclude that a hazard existed due to exposures to neodymium and iron-oxide. Thallium exposures may present a hazard if in soluble form. The authors recommend the reduction of worker exposure to neodymium, iron and thallium through engineering controls using local exhaust ventilation at the crushing, blending and jet milling operations. A respirator program should be implemented.

43395 (PB–89-188098/XAB) **Health-hazard evaluation report No. HETA-84-474-1946, Electric Boat Division, General Dynamics Corporation, Groton, Connecticut.** McManus, K.P.; Moseley, C.; Lowry, L.K.; Hattis, D.; Berg, R. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Jan 1989. 108p. (HETA–84-474-1946). Available from NTIS, PC A06/MF A01.

See also PB–85-100865.

An evaluation was made of possible hazardous working conditions at the Electric Boat Division of General Dynamics Corporation, Groton, Connecticut. The request concerned the potential for reproductive effects stemming from employee exposure to glycol ethers during submarine construction and refitting operations at this site. About 800 workers were potentially exposed during the application of coatings. The primary solvent in epoxy paints used at this facility was 2-ethoxyethanol (2-EE). Breathing zone airborne exposures to 2-EE ranged from nondetectable to 84.3 mg/cu m, with a mean concentration of 9.9 mg/cu m. Exposures to 2-methoxyethanol ranged up to 17.2 mg/cu m. A potential health hazard existed as a result of exposure to 2-EE at the time of the survey. The author recommends that worker exposure to glycol ethers be reduced to the lowest possible extent, that workers possibly exposed to these chemicals be provided with and required to use personal protective equipment, and that a continuous program of biological monitoring and industrial hygiene assessment be instituted for these workers.

43396 (PB–89-188114/XAB) **Health-hazard evaluation report No. HETA-87-099-1938, Louisiana-Pacific Corporation, Olathe, Colorado.** Daniels, W.J.; Hales, T.; Seligman, P. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Dec 1988. 45p. (HETA–87-099-1938). Available from NTIS, PC A03/MF A01.

An investigation was made at the Louisiana-Pacific Corporation, Olathe, Colorado, of respiratory problems possibly due to exposures at the workplace. The company produced waferboard using a heat- and pressure-cured resin/wax binding material containing 4,4-methylenediphenyl-isocyanate (MDI). Thirteen cases of pulmonary disease (12 cases of asthma and one case of hypersensitivity pneumonitis) were identified by medical testing in three current and 10 former employees. Two of 23 personal air samples contained quantifiable concentrations of MDI, for time-weighted average concentrations of 0.015 and 0.016 mg/cu m, below the NIOSH recommended exposure limit of 0.05 mg/me. The authors conclude that a potential health hazard existed from airborne exposure to diisocyanates. There may be a risk of significant exposure during maintenance activities if proper personal protective equipment is not used. Previously sensitized workers may react at very low concentrations. The authors recommend that engineering controls be maintained at a high level, that good housekeeping practices be adhered to, that a regular program of air monitoring be instituted, that signs warning the danger of exposure to diisocyanate be posted, that employees be instructed in the use of personal protective equipment, and that a program for medical screening be adopted.

43397 (PB–89-189401/XAB) **Crop loss due to the ozone in New England. Technical report.** Maldonato, T.J. Rutgers–the State Univ., New Brunswick, NJ (USA). 1988. 33p. Available from NTIS, PC A03/MF A01.

The report is part of the National Network for Environmental Management Studies under the auspices of the Office of Cooperative Environmental Management of the U.S. Environmental Protection Agency. Ozone is known to damage crops and forests; a national estimate of its detrimental effects on crops is 2-3 billion dollars per year. This paper quantifies the economic losses in New England due to ozone exposure. The monitored ozone values for each of the New England States and their means are established. The major cash crops grown in the area and their cash values are also presented. Using the Weibull function, a dose-response calculation for specific crops, a dollar value for crop loss is calculated. The dollar value for four crops (corn, hay, tobacco, and sweet corn) is estimated at approximately 12 million dollars (for the 1986 growing season). The New England forest species that are sensitive to ozone damage are also presented. Based on the lack of established Weibull functions for the other cash crops grown in New England and the lack of a method to quantify the cash value of forest damage due to ozone, the paper concludes that the economic loss in New England due to ozone is at least 12 million dollars per year.

43398 (PB–89-196828/XAB) **Effects of burn rate, wood species, moisture content, and weight of wood loaded on woodstove emissions. Report for December 1984-December 1985.** Leese, K.E.; Harkins, S.M. Research Triangle Inst., Research Triangle Park, NC (USA). May 1989. 400p. Available from NTIS, PC A17/MF A01.

This report gives results of tests of four woodstove operating parameters (burn rate, wood moisture, wood load, and wood species) at two levels each using a half-factorial experimental test design to determine statistically significant effects on the emission components CO, CO_2, particulate matter, total extractable organics (TEOs), polycyclic aromatic hydrocarbons (PAHs), C1-C7 hydrocarbons, metals, and the Ames plate incorporation bioassay mutagenic potential. Results showed that increasing burn rate lowered CO, particulate matter, TEO, and C1-C7 hydrocarbon emission rates. Increasing burn rate raised emission rates of individual PAHs and several metals, and also the mutagenic potential of the emissions. All of these effects were significant at the 90% or better confidence interval. At the 90% or better confidence interval, reducing wood moisture increased the particulate emission factor, while concentrations of several PAHs in the stack gas were lowered. Changing from pine to oak increased K emissions at the 90% confidence interval.

43399 (PB–89-861405/XAB) **Ozone depletion studies. January 1972-April 1989 (Citations from the International Aerospace Abstracts data base). Report for January 1972-April 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 88p. Available from NTISPC N01/MF N01.

U.S. sales only.

This bibliography contains citations concerning studies of atmospheric chemistry and modelling of ozone depletion in Antarctica, and the consequences of the depletion on ultraviolet radiation levels. The studies involve chemical reactions in the atmosphere, including temperature dynamics, possible changes in solar insolation, and effects of pollution from nitrogen, chlorofluorocarbons, carbon dioxide, and methane. The studies involve references to observations of the ozonosphere and modelling of interactions worldwide, together with data on the sources of the natural and man-made pollutants. (Contains 187 citations fully indexed and including a title list.)

43400 (PW–8805) **Indoor air quality building studies, 1987-1988.** Public Works Canada, Ottawa, ON (Canada). 1988. vp. (CE–02704). Available from Canada. Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, CAN K1A 0M2; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report is a collection of 8 indoor air pollution studies conducted in 1987-88 by the Building Performance Division of Public Works Canada. The environmental assessment comprises monitoring volatile organic compounds and microbials and other particulates. Recommendations are made in order to reduce air pollution. 3 refs., 10 figs., 26 tabs.

43401 (PW–8806-4) **Indoor air quality test kit user manual.** Public Works Canada, Ottawa, ON (Canada). 1988. vp. (CE–02709). Available from Canada. Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, CAN K1A 0M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Complaints about air quality in office buildings have increased considerably in the last 10 years, as energy consrervation measures have been implemented that sealed buildings more tightly and cut down the amount of fresh air being circulated. Because of the similarity in the symptoms of illness reported, the problem is often referred to as sick building syndrome. However, an approach based on investigating the buildings rather than the symptoms has proved to be more successful. The report lists air pollutants and their sources. An occupant complaint sheet is given. The report explains how to use various pollutant monitors and report the findings: CO_2, CO, formaldehyde, radon, NO_2, O_3, toluene, and particulates. Relative humidity and temperature should also be monitored. Ranges of acceptable values for each type of measurement are given. 8 figs., 2 tabs.

43402 (PW–8806-5) **Indoor air quality test kit maintenance manual.** Public Works Canada, Ottawa, ON (Canada). 1988. vp. (CE–02708). Available from Canada. Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, CAN K1A 0M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This manual contains copies of the manuals supplied by the manufacturers for all of the equipment in the test kit. The test kit is made up of the following: Fuji ZFP5 CO2 monitor, ISD CO260 CO monitor, STC formaldehyde Kit, Gastec tubes, and carbon dioxide and carbon monoxide monitors. A list of spare parts kept by the Building Performance Division of Public Works Canada is also included. Building Performance has carried out evaluations of the equipment in the test kit. Part of the information acquired has been included in the User Manual. The remainder is given here. 67 figs., 5 tabs.

43403 (PW–602031) **Methods for measuring volatile organic compounds, and types of chemicals found in building air.** Kerr, G. Public Works Canada, Ottawa, ON (Canada). 1988. 71p. (CE–02707). Available from Canada. Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, CAN K1A 0M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report contains: an evaluation of the different methods used by the Building Performance Division of Public Works Canada to measure volatile chemicals in indoor air, procedures for applying these methods in the field, and discussion and analysis of the results of case studies carried out using these methods within Canadian buildings. The 3 measurement methods evaluated have different strengths and different applications. The Environmental Health Centre Laboratory (EHCCL) uses an accredited method which determines the concentrations of individual chemicals in air; it should be used when comparisons with indoor air quality standars are required. The National Research Council (NRC) method samples a larger number of chemicals and determines their combined concentrations in air; it should be used when comparisons with indoor air quality standards are required. The National Research Council (NRC) method samples a larger number of chemicals and determines their combined concentration in air; the analysis is less time-consuming, and simpler to use in identifying complex chemical sources. Simple proccedures are given for the collection of samples for analysis by the EHCL and NRCC methods and for the operation of the photo-ionization detectors. The case studies indicated that hydrocarbons occur more frequently in building air than chlorinated hydrocarbons. Most of the chemicals found were associated with activities included printing, photocopying, painting and carpet laying. None of the measured concentrations exceeded the recommended limits.

43404 (SBM–8308) **Indoor air pollution and housing technology. Research report.** Small, B.M. Small (B.M.) and Associates Ltd., Goodwood, ON (Canada). 1983. 295p. (CE–02703). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This study reviews the scientific literature on indoor air pollution. Many materials and conditions which contribute significantly to indoor air pollution are known to be present in Canadian homes. Major pollutants include carbon monoxide, nitrogen oxides, radon gas, formaldehyde, tobacco smoke, ozone, asbestos, dust and mold, bacteria and viruses, and a host of organic chemical vapors, some of which are known or suspected carcinogens. The study states that indoor air pollution is a total population problem and that a significant number of Canadians are in high-risk categories with respect to pollutant exposure. There is a small but growing population of chemically susceptible persons in Canada who require low-pollution housing, low-pollution design and construction. Techniques employed in Sunnyhill Low-Pollution Research Centre are outlined and suggestions are made on their applicability to new and existing housing in Canada. Further research and discussion on this subject is advocated.. 376 refs., 28 figs., 42 tabs.

43405 Detection of multiply deuterated methane in the atmosphere. Mroz, E. J. (Isotope Geochemistry Group, Los Alamos National Laboratory, Los Alamos, New Mexico (US)); Alei, M.; Cappis, J. H.; Guthals, P. R.; Mason, A. S.; Rokop, D. J. *Geophysical Research Letters (USA),* 16(7): 677-678 (Jul 1989).

Measurements of the isotopic composition of methane in the Antarctic atmosphere have indicated the presence of either $^{12}CD_4$ or $^{12}CHD_3$. The concentration is about 1.3×10^{-16}(v/v). This concentration is at least 500 times higher than expected from the statistical combination of the natural isotopic abundances of H, D, ^{12}C and ^{13}C. There are no known sources of these species large enough to explain these concentrations. It is possible that these species have accumulated in the atmosphere by virtue of having atmosphere residence times that are substantially longer than the residence time of CH_4. © American Geophysical Union 1989

43406 Pollutant transport and diffusion in katabatic flows. Nappo, C. J. (Atmospheric Turbulence and Diffusion Division, NOAA/ARL, Oak Ridge, Tennessee (US)); Rao, K. S.; Herwehe, J. A. *Journal of Applied Meteorology (USA),* 28(7): 617-625 (Jul 1989).

The characteristics of pollutant transport and diffusion of a passive contaminant in a two-dimensional katabatic flow over a simple slope are examined using a primitive equation hydrodynamic model. It is shown that pollutants released above the drainage layer can be entrained into the layer and diffused to the ground surface. For elevated releases within the drainage layer, subsidence in the flow leads to relatively high surface concentrations of pollutants close to the stack. Pollutants released at ground level can spread through the entire depth of the drainage layer. This vertical diffusion is more effective for a shallow slope, resulting in higher concentrations at all heights, than for a steeper slope. These dispersion characteristics are quite different from those for stable flows over flat terrain. The differences result from increases of boundary-layer depth, wind speed, and turbulence as the katabatic flow develops downslope.

43407 Early morning ventilation of a gaseous tracer from a mountain valley. Orgill, M. M. (Atmospheric Science Department, Pacific Northwest Laboratory, Richland, Washington (US)). *Journal of Applied Meteorology (USA),* 28(7): 636-651 (Jul 1989). DOE Contract AC06-76RL01830.

An important component of a joint Environmental Protection Agency—Department of Energy field experiment in Brush Creek Valley, Colorado in July–August 1982, was an aircraft sampling task to help verify the early morning ventilation of a gaseous tracer from the valley. The aircraft sampling supplemented a surface sampling network in the 650 m deep northwest-southeast oriented valley. A 100 m elevated tracer release 11 km up Brush Creek Valley from its confluence with Roan creek Valley was sampled using an airborne real-time tracer analyzer supplemented with periodic grab bag samples. Three experiments were conducted in the early morning hours (0400–1000 MST) of 31 July, 4 August, and 6 August.

43408 Numerical simulation of cross-valley plume dispersion during the morning transition period. Bader, D. C. (Pacific Northwest Laboratory, Richland, Washington (US)); Whiteman, C. D. *Journal of Applied Meteorology (USA),* 28(7): 652-664 (Jul 1989). DOE Contract AC06-76RL01830.

A two-dimensional dynamical model was used to simulate the daytime boundary-layer evolution and resulting plume dispersion in a cross-valley section of a northwest-southeast oriented narrow valley in the first 4 h after sunrise. Two cases were simulated, one

using a summertime heating distribution and a second with a wintertime heating distribution. In each case, additional conservation equations were added to simulate the dispersion of two plumes released 150 m and 650 m above the valley floor. In the summer case, the lower plume migrated to the more strongly heated southwest sidewall in the first 90 min after sunrise, and was then advected up the sidewall in the slope flow for the remainder of the simulation. This result is consistent with observations. The upper plume diffused slowly in the remnants of the nocturnal inversion layer until it was entrained by the growing convective boundary layer 3 h after sunrise. The boundary layer's thermodynamic structure remained nearly symmetric about the valley axis throughout the transition period. The asymmetric dispersion characteristics seen in the summer case were not found in the winter simulation. The seasonal change in solar illumination reduced the differences in surface heat flux between the two sidewalls that gave rise to the asymmetry observed in the summer case.

43409 Transferability of a three-dimensional air quality model between two different sites in complex terrain. Lange, R. (Lawrence Livermore National Laboratory, University of California, Livermore, California (US)). *Journal of Applied Meteorology (USA)*, 28(7): 665-679 (Jul 1989). DOE Contract W-7405-ENG-48.

The three-dimensional, diagnostic, particle-in-cell transport and diffusion model MATHEW/ADPIC is used to test its transferability from one site in complex terrain to another with different characteristics, under stable nighttime drainage flow conditions. The two sites were subject to extensive drainage flow tracer experiments under the multilaboratory Atmospheric Studies in Complex Terrain (ASCOT) program: the first being a valley in the Geysers geothermal region of northern California, and the second a canyon in western Colorado. The domain in each case is approximately 10×10 km. The 1980 Geysers model evaluation is only quoted. The 1984 Brush Creek model evaluation is described in detail.

43410 Morning transition tracer experiments in a deep narrow valley. Whiteman, C. D. (Pacific Northwest Laboratory, Richland, Washington (US)). *Journal of Applied Meteorology (USA)*, 28(7): 626-635 (Jul 1989). DOE Contract AC06-76RL01830.

Three sulfur hexafluoride atmospheric tracer experiments were conducted during the post-sunrise temperature inversion breakup period in the deep, narrow Brush Creek Valley of Colorado. Experiments were conducted under clear, undisturbed weather conditions.

43411 Two-photon spectroscopy at ultrahigh resolution: Fine structure and hyperfine structure of the $(3s\sigma)A\ ^2\Sigma+(v=1,N=3)$ Rydberg state of NO. Miller, R. J. (Atomic and Molecular Chemistry Section, Pacific Northwest Laboratory, Richland, Washington 99352 (US)); Glab, W. L.; Bushaw, B. A. *Journal of Chemical Physics (USA)*, 91(5): 3277-3279 (1 Sep 1989). DOE Contract AC06-76RL01830.

The utility of ultrahigh resolution, continuous-wave laser sources in multiphoton spectroscopy is demonstrated by measurements of fluorescence excitation spectra resulting from two-photon pumping of individual rotational branches of $(3s\sigma)A\ ^2\Sigma+(v'=1,N'=3)\leftarrow X\ ^2\Pi(v'=0)$ NO. The general physical significance of fine structure and hyperfine structure interactions is briefly discussed emphasizing their relation to dynamical phenomena. Current observations yield the following fine structure and hyperfine structure parameters characterizing $A(v=1,N=3)$ NO: $\gamma=-80.10\pm0.04$ MHz, $b=40.9\pm0.2$ MHz, $c=1.5\pm4.5$ MHz, and $eQq=-7.2\pm0.5$ MHz. The effective cross section for two-photon excitation of $R_{11}(J'=2.5)$ is estimated from experimental observables to be 1×10^{-44} cm^4 s.

5003 Radioactive Materials Monitoring and Transport

Refer also to citation(s) 42103, 43201, 43450

43412 (AECL–9507) **ATMOS: a model of radionuclide migration in the atmosphere.** Wilkinson, S.R. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Oct 1987. 14p. Order Number DE89635132/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

For use with scenarios involving airborne contamination, an atmospheric transport model called ATMOS has been developed for the safety assessment code COSMOS-S/D. It is a one-wind Gaussian plume model, made more general using wind-rose information that calculates ground-level air concentration factors at a common receptor point for each of a number of sources. These multiply a source strength, calculated elsewhere, to obtain the actual airborne radionuclide concentrations. The model presented in this report is an improved version of the original. Accounting is now made of area of the source region, and plume depletion by both wet and dry deposition mechanisms.

43413 (BNWL-CC–167) **Proposal for second Hanford iodine-131 field release test.** Watson, E.C. Battelle Pacific Northwest Lab., Richland, WA (USA). 22 Jul 1965. 31p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-76RL01830. Order Number DE89015086/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

It is proposed to release two curies of iodine-131 to the atmosphere, at a point near the meteorology tower. The height of release would be about five feet above the ground. The principal objective of controlled atmospheric releases of iodine-131 is to determine the environmental consequences of an accidental emission. The proposed release of iodine-131 has the following objectives: will determine atmospheric diffusion parameters for molecular iodine released, as an aerosol, during stable atmospheric conditions; will determine possible chemical and physical changes of the released iodine as a function of downwind distance, travel time and atmospheric characteristics; and will determine the time-integrated air concentration at ground level of iodine-131 found as a function of downwind and horizontal cross-wind distances. 4 refs., 4 figs., 5 tabs.

43414 (CEA-R–5484) **Development of a calibration stand for the monitoring of atmospheric contamination by means of standard radioactive aerosols.** Ammerich, M. Conservatoire National des Arts et Metiers (CNAM), 75 - Paris (France); CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection Technique. 1989. 228p. (In French). Order Number DE89908155/JAW. Available from NTIS (US Sales Only), PC A11/MF A01.

After a reminder of both the main physical laws governing aerosols and fluid mechanics, the methods and technologies used to develop a calibration equipment for the monitoring of atmospheric contamination by means of standard radioactive aerosols are presented. The preliminary tests checked the chief performances of the stand, the characteristics of which had been established for the purpose of the certification of atmospheric contamination monitors. These 'dynamic' tests were devised to measure the coefficient of the effect of natural radioactivity on the measurement of man-made activity and the measurement efficiency of artificial alpha and/or beta activity for a given installation. The tests conducted on the various components of the stand demonstrated the good operation of the installation, which allowed to carry out certification tests on three detectors.

43415 (INIS-mf–11483, pp. 9) **Comparison of various systems of diffusion parameters for the calculation of the downwind- and crosswind activity concentration due to stack releases.** Beutmann, A. (Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic)); Rossbander, W.; Sahre, P. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

43416 (Juel-Conf–69, pp. 428-458) **Environmental monitoring of nuclear facilities.** Koelzer, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero. 1988. (CONF-8610246–: 15. annual convention of the Indonesian Petroleum Association, Jakarta (Indonesia), 7-9 Oct 1986). In *Joint German-Indonesian seminar on public acceptance, waste-management, and nuclear safety.* Order Number DE89795784/JAW. Available from NTIS (US Sales Only), PC A21/MF A01.

Environmental monitoring of nuclear facilities is part of general monitoring for environmental radioactivity all over the territory of the Federal Republic of Germany. General principles of environmental monitoring were formulated by the ICRP in 1965. In 1974 guidelines for measures of monitoring the environment of NPP incorporating LWR were drafted, which helped to standardize environmental monitoring programs. Since 1958, data on environmental radioactivity from measurements by authorized laboratories have been published in reports. (DG).

43417 (PB–89-172308/XAB) **Seasonal variations of radon and radon decay-product concentrations in single-family homes. Final report.** Hans, J.M.; Lyon, R.J. Environmental Protection Agency, Las Vegas, NV (USA). Office of Radiation Programs. Aug 1986. 46p. (EPA–520/1-86/015). Available from NTIS, PC A03/MF A01.

Radon and radon decay-product concentrations were measured weekly for a period of 1 year in 20 homes. A seasonal cycle was observed for the radon concentrations, with a low during the warmer months and a high during the cooler months of the year. Radon decay-product concentrations were found to generally follow the radon cycle, as expected. The equilibrium ratio was observed, however, to vary inversely with the radon and radon-decay product cycles. The indoor radon cycle for the 20 homes was also found to follow the inverse of the outdoor radon concentrations. Some speculation and supporting data are presented to explain the inverse indoor and outdoor relationships.

43418 (PB–89-863864/XAB) **Radon detection and measurement. January 1970-May 1989 (Citations from the COMPENDEX data base). Report for January 1970-May 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 112p. Available from NTISPC N01/MF N01.

Supersedes PB–88-868880.

This bibliography contains citations concerning the measurement of radon and radon-daughter isotopes in various environments. Radon measurement in homes and buildings, mines, rainwater, groundwater, soils, in the Arctic and other atmosphere, and in exhaled air is discussed. Radon-exhalation rates of building materials and mine tailings are noted. Analytic methods and equipment used to measure radon and radon isotopes are described. Radon detection as an earthquake prediction tool is briefly presented. (This updated bibliography contains 250 citations, 11 of which are new entries to the previous edition.)

5005 Site Resource and Use Studies

Refer also to citation(s) 43330

5006 Regulations

Refer also to citation(s) 42222, 43458, 43459, 43519

43419 (PB–89-169866/XAB) **Data-assessment reports for CEMS (continuous emission monitoring systems) at Subpart DA facilities.** Walsh, G. Entropy Environmentalists, Inc., Research Triangle Park, NC (USA). Mar 1989. 55p. Available from NTIS, PC A04/MF A01.

EPA promulgated minimum quality assurance (QA) requirements for Continuous Emission Monitoring Systems (CEMS) in 40 CFR Part 60 Appendix F. Appendix F requires the development of site-specific QA plans and the reporting of results of EPA specified QA activities each calendar quarter. The report of QA activities under Appendix F is called a Data Assessment Report (DAR). The DAR includes identifying and descriptive information for the CEMS, results of periodic audits, identification of periods when calibration drift exceeds specified criteria, identification of periods when the analyzers or CEMS are out of control (OOC), and descriptions of corrective actions in response to OOC conditions. The principal objective of the study is an evaluation of the information in DARs for the first and second quarters of calendar year 1988. Secondary study objectives include the establishment of contacts with agency staff who normally receive the DARs each quarter and identification of facilities for which DARs were apparently not received, for follow-up by the appropriate agency.

43420 (PB–89-169973/XAB) **Review of current methods for measuring particulate matter including condensables from stationary sources. Final report.** McCain, J.D.; Williamson, A.D. Southern Research Inst., Birmingham, AL (USA). Feb 1989. 31p. Available from NTIS, PC A03/MF A01.

The PM10 ambient-air particulate concentration standard has created a need for updating measurement methods for PM10 emissions (nominally 10 micrometers aerodynamic diameter and smaller) from stationary sources. Condensable emissions can be a significant portion of stack emissions. Further, since these substances primarily condense to particles less than 10 micrometers in diameter, they form a greater percentage of the PM10 fraction than of the total particulate matter emissions. Therefore, the need arises for developing a source test method which includes the condensable component of emissions. A review of possible techniques was conducted to determine current methodology and to make recommendations for research. Research is recommended on two approaches. One is a dilution method that simulates plume formation by mixing stack gases with conditioned ambient air and the other is an adaptation of utilizing the Method 5 back-half catch.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

Refer also to citation(s) 41839, 41929

43421 (DOE/NV/10630–T1) **Noteworthy mammal distribution records for the Nevada test site.** Medica, P.A. Reynolds Electrical and Engineering Co., Inc., Mercury, NV (USA). Jun 1989. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-89NV10630. Order Number DE89015932/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Nevada Test Site records for the gray fox Urocyon cinereoargenteus scottii and the dark kangaroo mouse Microdipodops meqacephalus sabulonis are substantiated, and a range extension for Mustela frenata nevadensis documented. 17 refs.

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Refer also to citation(s) 41585, 41586, 41740, 43262, 43356, 43450, 43479, 43480, 43481, 43483, 43484, 43492, 43498, 43503, 43629, 43636

43422 (AD-A–206240/4/XAB) **Development of a computerized penetrometer system for hazardous-waste-site soils investigations. Final report, September 1986-August 1988.** Cooper, S.S.; Malone, P.G.; Olsen, R.S.; Douglas, D.H. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, MD (USA). Technology Div. 30 Aug 1988. 79p. (AMXTH-TR-TE–88242). Available from NTIS, PC A05/MF A01.

An instrumented cone-penetrometer system was developed for use in the investigations of soils at hazardous-waste sites. The penetrometer is based on designs used for foundation investigations and includes instrumentation to measure tip penetration resistance, sleeve friction, and electrical resistivity. The unit includes a computer-based data-acquisition system that records input from the sensors and calculates indices related to the soil type. The resistivity module can detect the presence of soil contaminants that change the electrical properties of the soil. Field trials conducted with the penetrometer at Louisiana Army Ammunition Plant showed the penetrometer could be used to trace soil types and determine the extent of soil contamination at a closed waste-water evaporation pond. The penetrometer results were confirmed using standard soil sampling and laboratory-analysis techniques. The penetrometer produced no cuttings that required disposal, and the unit could be rapidly decontaminated.

43423 (AD-A–206244/6/XAB) **Environmental interactions of hydrazine fuels in soil/water systems. Final report, March 1985-September 1987.** Street, J.; Johnston, C.; Mansell, R.; Bloom, S.

Florida Univ., Gainesville, FL (USA). Dept. of Soil Science. Oct 1988. 312p. Available from NTIS, PC A14/MF A01.

Because the Air Force is the primary user of the rocket fuels, hydrazine (Hz), monomethylhydrazine (MMH), and 1,1-dimethylhydrazine (UDMH), it is responsible for the environmental implications associated with the transport, storage, and handling of these fuels. During handling, hydrazine fuels could inadvertently be released to the atmosphere and the surrounding aqueous and terrestrial environments. The studies are divided into the following five areas: aqueous and soil suspension studies, surface interaction studies, biological interaction studies, soil column studies, and soil transport modeling. The objective of this work is to determine the fate of hydrazine fuel released into an aqueous or soil environment. Aqueous degradation studies reveal that the extent of hydrazine degradation and the products formed are highly dependent upon several variables. Among these include the type of container used in the studies, the presence of certain metal ions, the ionic strength, the presence and type of pH buffer, the temperature, the presence of bacteria, and the amount of dissolved oxygen. Aqueous hydrazine degradation is particularly rapid in quartz vessels with copper ions ions and oxygen present. Degradation also increases with increasing ionic strength, pH buffer concentration, temperature, and bacteria content.

43424 (AD-A–206929/2/XAB) **Solid-waste-assessment testing. Installation-restoration program. State 3. McClellan Air Force Base. Final report, November 1987-December 1988.** Radian Corp., Sacramento, CA (USA). 30 Dec 1988. 275p. Available from NTIS, PC A12/MF A01.

Availability: Document partially illegible.

This document reports the sampling and analytical results of the gas-generation and gas-migration testing at 13 inactive landfills, and the vapor wells and gas vents associated with the Area D clay cap remedial action. This report and testing were performed at McClellan AFB in compliance with the California Health and Safety Code Section 41805.5.

43425 (CONF-8906190–1) **Performance of in situ soil venting system at jet fuel spill site.** DePaoli, D.W.; Herbes, S.E.; Elliott, M.G. Oak Ridge National Lab., TN (USA). [1989]. 22p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. From EPA soil vapor extraction technology workshop; 28 Jun 1989. Order Number DE89015870/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Air Force Engineering and Services Center and Oak Ridge National Laboratory (ORNL) are performing a field demonstration of in situ venting at a 27,000-gal jet fuel spill site at Hill Air Force Base (AFB), Utah. In situ soil venting is a soil cleanup techniques that uses vacuum blowers to pull large volumes of air through contaminated soil. The air flow sweeps out the soil gas, disrupting the equilibrium existing between the contaminants on the soil and in the vapor. This causes volatilization of the contaminant and subsequent removal in the air stream. In situ soil venting has been used for removing volatile contaminants such as gasoline and trichloroethylene, but a full-scale demonstration for removing jet fuel from soil has not been reported. This paper briefly describes the jet fuel spill site and the design and results to date of our full-scale in situ soil venting system. 8 refs., 9 figs.

43426 (CPS–8702) **Proceedings [of the] 4th technical seminar on chemical spills.** Environnement Canada, Ottawa, ON (Canada). Conservation et Protection. 1987. 362p. (CONF-870295–: Technical seminar on chemical spills, Toronto (Canada), 9-12 Feb 1987; MICROLOG–87-01873). Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A conference on chemical spills presented papers in the fields of fate and behavior of various chemical products such as heavy gases and fuels; mathematical modelling of spills; spill countermeasures and site restoration; analysis and detection of hazardous materials and contaminants; and research connected with specific spill events. Separate abstracts have been prepared for 14 papers from this conference.

43427 (CPS–8702, pp. 77-113) **Quantification of fire hazards of liquid spills from tank trucks.** Crocker, W.P. (Univ. of Toronto, Toronto, ON, Canada); Napier, D.H. Environnement Canada, Ottawa, ON (Canada). Conservation et Protection. 1987. (CONF-870295–: Technical seminar on chemical spills, Toronto (Canada), 9-12 Feb 1987; MICROLOG–87-01873). In *Proceedings [of the] 4th technical seminar on chemical spills.* Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The quantification of fire hazards associated with the bulk transport of liquid by road carrier is considered by studying two classes of liquids, flammable liquids and liquefied petroleum gases, in view of the differing fire hazards that they present. The vehicle configuration chosen in this study is the tractor plus semitrailer. Several fire systems were modelled for each class. Confined and unconfined pool fires were considered for flammable liquids and fireballs were modelled for propane and butane. In different accident scenarios, distances for various levels of thermal radiation and for contact ignition were predicted. Flammable liquid spills of ethanol, gasoline, hexane, kerosene and toluene were compared. Models of thermal radiation of fires are described including the model limitations. Significant findigns include the following. For confined pool fires, toluene is the most hazardous of the fuels considered, and ethanol the least. Atmospheric attenuation caused reductions up to 20% (confined pool fire) in the hazard distances predicted. Ethanol represents the greatest contact ignition hazard from catastrophic failure of tank contents (175 m for 40,000 kg spilled). Buildings are in hazard from unconfined pool fires (catastrophic failure), e.g. 176 m from pool centre for kerosene based on spontaneous ignition. Maximum radius for 1% lethality is 318 m for kerosene (40,000 kg spilled). Radius for blistering of skin is 553 m. Propane is more hazardous than butane: the distance to the pain threshold for propane is 487.6 m for 27 tonnes released, 278 m for butane. Models for confined and unconfined pool fires (catastrophic failure) are found to be suitable for use in hazard assessment. 30 refs., 18 figs., 21 tabs.

43428 (CPS–8702, pp. 53-76) **Modelling the evaporation of volatile liquids and spreading of chemicals on snow and ice.** Kawamura, P.I. (Univ. of Toronto, Toronto, ON, Canada); Mackay, D. Environnement Canada, Ottawa, ON (Canada). Conservation et Protection. 1987. (CONF-870295–: Technical seminar on chemical spills, Toronto (Canada), 9-12 Feb 1987; MICROLOG–87-01873). In *Proceedings [of the] 4th technical seminar on chemical spills.* Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper describes studies of two aspects of the short-term behaviour and fate of chemicals resulting from terrestrial chemical spills. In the first study, 2 models were developed to estimate the evaporation rate of liquids. Both models are based on steady heat balances around the chemical pool and include the effects of solar insolation, evaporative cooling, and heat transfer from the ground. The simpler of the two estimates the evaporation rate directly from available physical-chemical data. The second model determines the surface temperature of the evaporating pool by an iterative procedure. This temperature is then used to estimate the evaporation rate. Experiments are described in which the evaporation rates of seven volatile chemicals were measured from pans under known meteorological conditions. The two modes and the experimental evaporation rates were in satisfactory agreement. It is concluded that either model can be used to estimate evaporation rates under actual spill conditions. In the second study, a relatively simple model has been developed to describe the spreading of liquid chemicals on snow and ice. Experiments were performed to determine the spreading behaviour and characteristics and the general phenomena which occur when various chemicals are spilled on snow and ice. The final spill area and the spreading rate results were correlated with the spill volume, viscosity and snow depth and properties. These correlations can be viewed as comprising part of the general spreading model, and are believed to enable predictions

to be made of the spreading behaviour for most chemcials under actual spill conditions. 4 refs., 4 figs., 5 tabs.

43429 (CPS–8702, pp. 21-41) **A rapid assessment model for spills on soil of oily fluids that are immiscible with water.** Metcalfe, D.E.; Zukovs, G. Environnement Canada, Ottawa, ON (Canada). Conservation et Protection. 1987. (CONF-870295–: Technical seminar on chemical spills, Toronto (Canada), 9-12 Feb 1987; MICROLOG–87-01873). In *Proceedings [of the] 4th technical seminar on chemical spills.* Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A subsurface transport model has been developed for spills on soil of oily fluids that are immiscible with water. This rapid assessment tool has been developed for spill respondents who are not necessarily contaminant transport specialists for use in evaluating the environmental severity and impacts of spills and determining the need for emergency actions. As such, model inputs are limited to the key data requirements, with guidelines provided on the selection of those data. The model equations are presented in nomogram format, allowing the migration distances and times of the conta minant fluid to be obtained. The model accounts for the downward migration of contaminant fluids and the behavior of these fluids at the water table, for both fluids that are less dense and more dense than water. The nomograms describing these phenomena are based on Dracian flow concepts and published experimental work. Step-by-step instructions are provided in a worksheet format on the use of the nomograms for obtaining estimates of depths of penetration at specified times, the time of penetration to the water table, the extent of potential contamination at the water table, and the ultimate subsurface configuration of the contaminant fluid. 17 refs., 10 figs., 3 tabs.

43430 (CPS–8702, pp. 11-20) **Modelling of the spreading of chemical spills on grass and impermeable surfaces.** Belore, R.L. (Ross Environmental Research, Ottawa, ON); McBean, E.A. Environnement Canada, Ottawa, ON (Canada). Conservation et Protection. 1987. (CONF-870295–: Technical seminar on chemical spills, Toronto (Canada), 9-12 Feb 1987; MICROLOG–87-01873). In *Proceedings [of the] 4th technical seminar on chemical spills.* Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Two- and three-dimensional spill models of the spread of liquids on land have been developed. Evaporative and infiltrative fluxes are estimated as losses of liquid, in combination with the surface affinity depth and position-computing methods to develop time-varying spill profiles. The model results are compared with physical modelling experiments. Sensitivity analyses are used to identify parameters to which the model is most sensitive. These analyses indicated that differences in density and contact angle were of lesser importance in forecasting spill excursions than are variations in the slope of the solid surface. Additional, fundamental data characterizing parameters such as friction coefficients and contact angles, as needed for model application, are important for future utility of the model. 16 refs., 9 figs., 2 tabs.

43431 (CPS–8702, pp. 149-163) **A new generation of spill model.** Mackay, D. (Univ. of Toronto, Toronto, ON, Canada); Wilson, D. Environnement Canada, Ottawa, ON (Canada). Conservation et Protection. 1987. (CONF-870295–: Technical seminar on chemical spills, Toronto (Canada), 9-12 Feb 1987; MICROLOG–87-01873). In *Proceedings [of the] 4th technical seminar on chemical spills.* Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Chemical and oil spill modelling has reached a state of limited development. The simple, easily understandable models do not treat all the important processes and may give misleading results. The more comprehensive, complex models can only be understood by the developer. They may contain errors buried in the mass of undecipherable computer code. Neither is satisfactory, but it is not clear how the situation can be improved. It is suggested that a new generation of spill models may be on the horizon which are simple but comprehensive. At any given stage in the spill history, only a few of the many possible flow, transfer and reaction processes are important. Rather than include descriptions of all processes at all times, the user would be able to select and include the important processes, but is advised as to which processes are likely to be most important. As the spill progresses, the user is able to intervene to change the selection of events which occur at specific times such as changing environmental conditions, countermeasures, interactions with shorelines, penetration into soils of differing properties, and interactions with ice. The conditions of the spill can be adjusted to agree with actual observations. The principles underlying this new model approach are described, with reference to chemical and oil spills. 4 refs., 2 figs.

43432 (CPS–8702, pp. 223-228) **Unique hazardous materials spill control agents and methods of application.** Riley, J.F. (Ansul Fire Protetion, Marinette, Wisconsin, USA). Environment Canada, Ottawa, ON (Canada). Conservation and Protection. 1987. (CONF-870295–: Technical seminar on chemical spills, 9-12 Feb 1987; MICROLOG–87-01873). In *Proceedings [of the] 4th technical seminar on chemical spills.* Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A technology is described for treating spills of hazardous materials. This technology is based upon new solid formulations for treating spills of three broad classes of hazardous materials. Three different formulations have been developed for treating acids, caustics and organic solvents and fuels. In most cases these materials react to render a hazardous material into a non-hazardous material. These formulations are mated with external expellent gas cartridge applicators ranging in size from 30 to 5000 lbs. This results in a safe, fast way of reacting to and treating spills of hazardous materials. 3 refs., 5 tabs.

43433 (CSC–143-G-299) **Development of SERTAD. Incorporation of nitrogen chemistry. Part 7.** Davis, C.S.; Fung, C.S. Concord Scientific Corp., Toronto, ON (Canada). 1989. 56p. (CE–02698). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A new version of the Statistical Evaluation of Regional Transport and Acid Deposition (SERTAD) modelling system that incorporates nitrogen chemistry has been prepared. This version, which utilizes the latest formulation of Fisher's statistical model, allows the treatment of two secondary nitrogen species (nitric acid and particulate nitrate in this case) and also allows the deposition velocity and scavenging coefficients of primary and secondary species to be varied independently. The new version includes the treatment of dry deposition for sulphate. The version is limited in that it allows only one rainfall category (compared with 10 in the previous sulfur version) and requires that the two secondary nitrogen species be formed in a fixed ratio to each other. The use of one rainfall category does not appear to be a serious limitation. The new version has been implemented on an IBM compatible personal computer. Preliminary comparisons of model predictions with anuual (1982) wet nitrate deposition data are promising (Pearson correlation coefficients of about 0.7 based on 38 data points using 1980 emissions and meteorological data). More detailed model testing and enhancement to incorporate more rainfall categories, the diurnal and seasonal variation of transformation and deposition and model validation are recommended. 26 refs., 15 figs., 8 tabs.

43434 (DOE/HWP–74) **Hazardous Waste Remedial Actions Program: Annual progress report for the period ending September 30, 1988.** Oak Ridge National Lab., TN (USA). Hazwrap Support Contractor Office. Jul 1989. 207p. Sponsored by

U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. Order Number DE89016429/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

This report covers the activities of the HAZWRAP Support Contractor Office (SCO) during FY 1988 in support of the three programs. These programs are managed in an interactive fashion, particularly the technology projects. However, each program is administered separately and has its own Program Management Plan. Following a general summary and introduction for HAZWRAP activities, each program is presented separately. Background and summary information are followed by more detailed information. SCO activities are described in substantial detail. The field element task sections constitute separate annual reports for each field task prepared by the principal investigator. In the case of research and development tasks, they are rather extensive. Two appendixes are included: Appendix A lists all of the HAZWRAP documents published in FY 1988, and Appendix B lists all of the formal reports published by HAZWRAP since its inception.

43435 (GEPP-SP-1122) **Pinellas Plant Spill Prevention Control and Countermeasures Plan.** Klein, R.D. General Electric Co., Largo, FL (USA). Neutron Devices Dept. Aug 1988. 35p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00656. Order Number DE89016326/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This Spill Prevention Control and Countermeasures Plan (SPCC) manages emergency response cleanup efforts for the release of oil and petroleum products. A separate document, GEPP-SP-1104, "The Pinellas Plant Contingency Plan for the Hazardous Waste Management Facility," manages emergency response cleanup efforts for the release of hazardous substances. 4 figs., 3 tabs.

43436 (PB-89-180095/XAB) **Electromembrane process for recovery of lead from contaminated soils. Phase 1, final report.** Kemner, W.; Krishnan, R. PEI Associates, Inc., Cincinnati, OH (USA). Jul 1986. 158p. Available from NTIS, PC A08/MF A01.

The research optimized, through bench-scale tests, the process variables for the chelation and electroplating operations of an electromembrane process employing a chelating agent, ethylenediaminetetraacetic acid (EDTA), for recovery of lead in contaminated soils. Preliminary evaluations of process applicability for various sites were conducted, scale-up design criteria were investigated, and the economics of the process were estimated. The process is applicable to a wide variety of lead-containing soils and wastes. Desirable process criteria include uniform size distribution, high soluble lead content, low clay and fines content, and good dewatering characteristics. Economic analyses show its cost to be competitive with off-site disposal options.

43437 (PB-89-181309/XAB) **Gas-chromatographic determination of aviation gasoline and JP-4 jet fuel in subsurface core samples (journal version).** Vandegrift, S.A.; Kampbell, D.H. Northrop Services, Inc., Ada, OK (USA). 1988. 6p. Available from NTIS, PC A02/MF A01.

Pub. in Jnl. of Chromatographic Science, Vol. 26, 566-569(Nov 1988).

A new gas-chromatographic procedure for quantifying levels of aviation gasoline (avgas) and JP-4 jet fuel contamination in soils is described. The fuel is extracted from a small quantity of soil or subsurface material, typically about 6 g, using 3 mL of methylene chloride. The extract is analyzed by wide-bore capillary-column gas chromatography with flame-ionization detection. Advantages of the method are a short analysis time of 20 minutes, the use of small amounts of solvent, detection limit in the low parts-per-million range, and determination of the type of fuel contamination (i.e. avgas or jet fuel) by the chromatographic pattern or fingerprint.

43438 (PB-89-861587/XAB) **Leachate treatment. January 1977-April 1989 (Citations from the Selected Water Resources Abstracts data base). Report for January 1977-April 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 140p. Available from NTISPC N01/MF N01.

Supersedes PB-88-857917.

This bibliography contains citations concerning treatability studies on leachate from landfills and solid-waste disposal sites. Biological treatment, chemical coagulation, carbon adsorption, resin adsorption, membrane processes, and stripping are among the treatment processes discussed. (This updated bibliography contains 228 citations, 44 of which are new entries to the previous edition.)

43439 (UCRL-53927) **A summary of research, assessment, and management capabilities applicable to the fields of hazardous waste, toxic materials, and environmental contamination.** Lawrence Livermore National Lab., CA (USA). 13 Apr 1989. 19p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89014002/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Lawrence Livermore National Laboratory has a 30-year history of research and development in energy and weapons technologies. As a result, the Laboratory has developed expertise in dealing with environmental, health, and waste-management problems associated with hazardous and toxic materials. This document, developed by a multidisciplinary working group, outlines the capabilities the Laboratory can bring to bear on issues related to waste, toxic, and environmental problems.

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Refer also to citation(s) 41734, 41757, 42087, 42091, 42103, 42666, 42695, 43413, 43416, 43598

43440 (AECL-9610) **Mass transport in saturated porous media. Estimation of transport parameters.** Moltyaner, G.L.; Champ, D.R. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Nov 1987. 45p. Order Number DE89635084/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Equilibrium and kinetic sorption models were used to simulate the transport of reactive solutes, ^{85}Sr and ^{51}Cr-EDTA, through small-scale laboratory columns. The least squares fitting procedure was used to calculate the model parameters and to simulate experimental results. Parameters of equilibrium and kinetic models were also determined using time moments analysis. Both methods provide virtually identical estimates of the flow velocity and dispersion coefficient. There is, however, a difference in estimates of rate constants due to sensitivity of the moment calculation procedure to the tail of breakthrough curve. It was concluded that the application of both techniques ensures accuracy in parameter estimation. Equilibrium models based on linear and nonlinear isotherms as well as reversible first order and two-site kinetic models were used to simulate the observed ^{85}Sr breakthrough curves. In view of a good agreement between measured results and those simulated using the two-site kinetic and equilibrium models it was concluded that the equilibrium model may be used for describing the radiostrontium behaviour. The application of two-site kinetic model for simulating ^{51}Cr-EDTA breakthrough curve resulted in the excellent agreement between simulated and observed results. 23 refs.

43441 (CEA-R-5473) **Contribution to the prediction of americium, plutonium and neptunium behaviour in the geosphere: chemical data.** Robouch, P. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI); Strasbourg-1 Univ., 67 (France). 1989. 216p. (In French). Order Number DE89908104/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

An exhaustive bibliographic review on hydrolysis of americium gives the stability constants, at zero ionic strength. No evidence of $Am(OH)_4^-$ formation was found by solubility studies up to pH < 13. The solubility of solid $Am_2(CO_3)_3$ characterised by its X-ray diffraction pattern is studied at a high ionic strength. All the published results on Am in carbonate media are reinterpreted using these stability constants (Am-OH-CO_3 complexes are not needed). No evidence of $Am(CO_3)_4^{5-}$ formation was found by spectrophotometry up to 3M. Literature results are used to determine the formal redox potentials at pH = 9.4 and to calculate the formation constants, at zero ionic strength. The formation of complexes between americium and humic materials (purified fulvic and humic acids) has been

studied by a spectrophotometric technique. The results are interpreted by the formation of a 1:1 complexe. Solubility of the solid $PuO_2(CO_3)$ is measured in bicarbonate media at high ionic strength, to obtain the solubility product and formation constants of the $PuO_2(CO_3)_i^{2-2i}$ complexes.

43442 (INIS-mf–11483, pp. 16) **Investigations into measures for the restarting of ventilation systems located in fallout areas.** Czarwinski, R. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
Abstract only.

43443 (INIS-mf–11495, pp. 10-13) **Radionuclide migration through large granitoid bodies : selection criteria for high-level nuclear waste disposal sites.** Guthrie, V.A. (Tasmania Univ., Sandy Bay (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711312–: 5. Australian conference on nuclear techniques of analysis, 4-6 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Uranium concentration and distribution and actinide mobility within two granitoid bodies in Australia have been investigated using electron microprobe analysis, and fission-track and alpha track micromapping to evaluate individual minerals as natural analogues of radionuclide mobility within large granitoid bodies to assist in the assessment of their suitability as disposal media for high-level nuclear waste. Fission-track micromapping and electron microprobe element mapping shows that uranium is unevenly distributed between three mineralogical locales, and is redistributed during further alteration of secondary and interstitial minerals, implying the dominant mechanisms for fixation are adsorption and ionic exchange. Further evidence of mechanisms is provided by the preferential concentration of alpha activity from a Pu-doped solution by secondary and interstitial minerals which thus assist in limiting radionuclide migration through a potential repository rock. Hydrothermal alteration may therefore be considered a desirable characteristic for potential granitoid disposal media for high-level nuclear waste.

43444 (INIS-mf–11495, pp. 163-165) **Assessment of techniques for determining accessible uranium in geologic material.** Payne, T. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711312–: 5. Australian conference on nuclear techniques of analysis, 4-6 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Two techniques for determining accessible natural uranium in geologic samples are compared. The first involves equilibrating the solid with a simulated natural groundwater to which ^{236}U has been added and measuring the level of uranium isotopes in the aqueous phase at equilibrium. The amount of accessible uranium is inferred from the relative levels of ^{236}U and ^{238}U in solution. In the alternative technique, the sample is extracted with a reagent chosen to remove accessible uranium. The success of this method is dependent on the selection of an appropriate extractant.

43445 (INIS-mf–11495, pp. 157-159) **Measurement of uranium series nuclides in rock bordering a fracture.** Nightingale, T.J. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711312–: 5. Australian conference on nuclear techniques of analysis, 4-6 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Alpha spectrometry was used to measure the $^{234}U/^{238}U$ and $^{230}Th/^{234}U$ activity ratios in crushed, thinly-cut sections of rock running parallel to a major fracture, as well as in the fracture-filling material. In addition, gamma spectrometry was used to measure the level of ^{226}Ra in each sample, enabling the $^{226}Ra/^{230}Th$ activity ratios to be estimated. The results show the highest concentration of uranium to be in the fracture, while the influence of groundwater on the surrounding rock could be seen by sharp variations in activity ratios within a few centimetres of the fracture. The use of a mild leaching reagent showed ^{234}U to be located in more potentially mobile sites than ^{238}U. The experiment provides a basis for further study of the role of fractures in crystalline rock in promoting the transport of uranium series nuclides. Fractures are considered to be a potential source of mobilisation of radionuclides from a deep radioactive waste repository, so data of the sort described here are considered useful for validation of radionuclide transport models.

43446 (KFK–4517) **The transfer of iodine-127 from fodder to cow's milk.** Neck, C. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Chemie. May 1989. 94p. (In German). Order Number DE89796043/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The transfer factor of iodine from fodder to cow's milk was estimated by means of measuring the concentration of iodine-127 in samples of fodder and milk. The method of determination: 1. Sample preparation, freeze-drying, homogenization, preparation of pellets; 2. Combustion of the organic material in an 'oxygen combustion bomb' and absorption of the liberated iodine in Na_2CO_3-solution. 3. Inversvoltammetric determination of iodide in the Na_2CO_3-solution. All analyses were carried out with the addition of I-123 as radioactive tracer for the chemical yield. The transfer factor, calculated from the results of these determinations is, assuming a medium daily fodder reception of 55 kg/d: $1.25x10^{-2}$ +/- $1.2x10^{-2}$ d/L. Assuming a daily fodder reception of 65 kg/d the transfer factor is: $1.1x10^{-2}$ +/- $1.0x10^{-2}$ d/L. The large error is caused by the wide variation of the iodine content of fodder and milk during the green fodder period. The error due to the standard deviation of the analytical procedure is only 40%. (orig./HP).

43447 (NIRS-RSD–82) **Radioactivity survey data in Japan, part 1. Environmental materials.** National Inst. of Radiological Sciences, Chiba (Japan). Oct 1988. 28p. Order Number DE89906611/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report presents data obtained through a radioactivity survey. Various environmental and dietary materials are collected for analysis. Rain and dry fallout are collected monthly. Airborne dust is collected every three months. Service water samples are taken semiyearly at the intake of watertreatment plants and at the tap. Freshwater is taken once a year (fishing season). Soil samples are collected once a year from two layers at different depths. Sea water is collected once a year at fixed stations where the effect of terrestrial fresh water from rivers is expected to be negligible. Sea sediments are collected once a year in the same area as that for the sea water sample. A full one day ordinary diet including three meals, water and tea for five persons is collected semiyearly as a sample of 'total diet'. Polished rice is collected in producing districts and in consuming areas. Raw milk is collected in producing districts and commercial milk is purchased in consuming districts. Vegetable are collected semiyearly in producing and consuming districts. Tea samples are also collected semiyearly. Fish, shellfish and seaweeds are collected once a year. Test solutions are prepared from these samples. Strontium-90 and cesium-137 are separated and subjected to quantitative determination. Results obtained are tabulated. (N.K.).

43448 (NRCN(LS)–021) **Movement of tritium in ecological systems.** Polevoy, Y; Laichter, Y. Israel Atomic Energy Commission, Beersheba (Israel). Nuclear Research Center-Negev. Nov 1988. 44p. (In Hebrew). Order Number DE89632926/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This literature survey summarizes the interaction of tritium gas and tritiated water with various components of the ecological system. The intake of tritium gas and tritiated water in plants and soil is described as well as the location of the highest measurable concentration. This information may serve as a basis for risk assessment from tritium to man through the food chain and enables effective tracing of its concentration in the environment. (author). 30 refs.; 10 figs.; 17 tables.

43449 (NSS/R–121) **Sorption of radionuclides on geological samples from the Bradwell, Elstow, Fulbeck and Killingholme site investigations.** Berry, J.A.; Coates, H.A.; Green, A.; Littleboy, A.K. United Kingdom Nirex, Ltd., Harwell (UK). Jun 1988. 20p. (AERE-R–13025). Order Number DE89635086/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The sorption of chloride, caesium, calcium, nickel and americium on geological samples collected during the site investigations at Bradwell, Elstow, Fulbeck and Killingholme has been studied. Through-diffusion and batch sorption techniques were used and experiments were designed to give a direct comparison between the sorptive behaviour of material from each site. (author).

43450 (ORF–P-5340/FG) **Development and evaluation of soil gas sampling techniques.** Piersol, P.; Fugler, D. Ontario Research Foundation, Sheridan Park, ON (Canada). 1987. 92p. (CE–02710). Available from Canada Mortgage and Housing Corporation, Annex Bldg., 628 Montreal Rd., Ottawa, ON, CAN K1A 0P7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

As a consequence of the investigations on indoor radon, air infiltration and moisture in residential buildings, it has been determined that there may be a potential for significant entry of soil gas into basements or crawlspaces. This soil gas may also have the potential of containing various contaminants such as radon, methane, and other organic compounds and fungi which may have an adverse effect on indoor air quality. This report describes the development and evaluation of soil gas sampling techniques that would be suitable for a wide soil gas entry survey of Canadian housing. Two types of soil gas sampling devices were fabricated and tested. Three residences were selected for field evaluations of the probes and containers; conditions at these residences represented a variety of soil geological and have construction characteristics. Soil gas pressure profiles and the resulting soil gas flow patterns were found not to be uniform. The in situ pressures were higher than reported literature values by several orders of magnitude; this was due to the confined condition of the soil. Active sampling of organic constituents from the probes located above the water table and from the entry point containers was successfully conducted. The low level of soil gas constituents found at the three test homes made evaluation of the sampling techniques and interpretation of the results difficult. The tests for organic compounds, pesticides and fungal growth were at or below the analytical detection limits. However, radon levels were consistently measurable. Based on the ratio of radon concentrations, for the 3 homes investigated the soil gas entry was 1.1% to 3.8% of the entire home air infiltration. 33 refs., 14 figs., 8 tabs.

43451 (ORNL/RASA–88/41) **Results of the radiological survey at 17 Redstone Lane, Lodi, New Jersey (LJ030).** Foley, R.D.; Floyd, L.M.; Carrier, R.F.; Crutcher, J.W. Oak Ridge National Lab., TN (USA). Jun 1989. 15p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89015403/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 17 Redstone Lane, Lodi, New Jersey (LJ030), was conducted during 1985 and 1986. Results of the survey demonstrated radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions are typical of the type of material originating from the MCW site. 4 refs., 7 figs., 3 tabs.

43452 (ORNL/RASA–88/42) **Results of the radiological survey at 10 Hancock Street, Lodi, New Jersey (LJ031).** Foley, R.D.; Floyd, L.M.; Carrier, R.F.; Crutcher, J.W. Oak Ridge National Lab., TN (USA). Jun 1989. 11p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89015404/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling from radionuclide analyses. The survey of this site, 10 Hancock Street, Lodi, New Jersey (LJ031), was conducted during 1985 and 1986. Results of the survey demonstrated radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions are typical of the type of material originating from the MCW site. 4 refs., 4 figs., 3 tabs.

43453 (ORNL/RASA–88/44) **Results of the radiological survey at 2 Branca Court, Lodi, New Jersey (LJ036).** Foley, R.D.; Floyd, L.M.; Carrier, R.F.; Crutcher, J.W. Oak Ridge National Lab., TN (USA). Jun 1989. 13p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89015405/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1961 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 2 Branca Court, Lodi, New Jersey (LJ036), was conducted during 1985 and 1986. Results of the survey demonstrated radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions are typical of the type of material originating from the MCW site.

43454 (ORNL/RASA–88/52) **Results of the radiological survey at 4 Branca Court, Lodi, New Jersey (LJ037).** Foley, R.D.; Floyd, L.M.; Carrier, R.R.; Crutcher, J.W. Oak Ridge National Lab., TN (USA). Jun 1989. 20p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89015402/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW

to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 4 Branca Court, Lodi, New Jersey (LJ037), was conducted during 1985 and 1986. Results of the survey demonstrated no radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. However, this property is apparently located directly over the old Lodi Brook streambed. This factor in combination with the elevated gamma logs of several auger holes is sufficient to recommend this site for inclusion in the DOE remedial action program. 5 refs., 5 figs., 4 tabs.

43455 (ORNL/RASA–88/53) **Results of the radiological survey at 6 Hancock Street, Lodi, New Jersey (LJ033).** Foley, R.D.; Floyd, L.M.; Carrier, R.F.; Crutcher, J.W. Oak Ridge National Lab., TN (USA). Jun 1989. 28p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89015406/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth, earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 6 Hancock Street, Lodi, New Jersey (LJ033), was conducted during 1985 and 1986. Results of the survey demonstrated radionuclide concentrations in excess of the DOE Formerly Utilized Remedial Action Program criteria. The radionuclide distributions are typical of the type of material originating from the MCW site.

5105 Site Resource and Use Studies

Refer also to citation(s) 41564

43456 (CPS–8702, pp. 75-184) **Restoration of sites contaminated by polyaromatic hydrocarbons (PAHs).** Paquin, J. (Sanexen International Inc., Anjon, PQ, Canada); Pilon, A. Environnement Canada, Ottawa, ON (Canada). Conservation et Protection. 1987. (CONF-870295–: Technical seminar on chemical spills, Toronto (Canada), 9-12 Feb 1987; MICROLOG–87-01873). In *Proceedings [of the] 4th technical seminar on chemical spills.* Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Several sites have recently been discovered to be contaminated with considerable quantities of tar. The tar is located in damaged underground tanks, abandoned dumps and even in river bottoms. It presents a difficult problem since it often contains important quantities of compounds in the family of polyaromatic hydrocarbons some of which have a carcinogenic potential. Some case histories are presented outlining methods used for the handling, treatment, and destruction of these contaminants. The following processes are reviewed: solidification of the viscous semi-liquid tar, ultrasorption for the treatment of contaminated water, and biolysis for destruction of the organic contaminants and detoxification of the waste material. 4 refs., 6 tabs.

5106 Regulations

Refer also to citation(s) 42222, 42367, 43495, 43519, 43530, 43533, 43536, 43537

43457 (PB–89-169205/XAB) **Bioremediation of hazardous-waste sites workshop: speaker slide copies and supporting information.** Environmental Protection Agency, Cincinnati, OH (USA). Center for Environmental Research Information. Feb 1989. 215p. (CERI–89-11). Available from NTIS, PC A10/MF A01.

Also available from Supt. of Docs.

Contents include: basic requirements for implementing biological systems to remediate hazardous wastes; initial data requirements; example site for bioremediation; reactor design; in-situ design.

43458 (PB–89-180053/XAB) **Air/Superfund national technical guidance study series, Volume 2. Estimation of baseline air emission at Superfund sites. Interim report(Final).** Radian Corp., Sacramento, CA (USA). Jan 1989. 246p. Available from NTIS, PC A11/MF A01.

This volume is one in a series of manuals prepared for EPA to assist its Remedial Project Managers in the assessment of the air contaminant pathway and developing input data for risk assessment. The manual provides guidance on developing baseline-emission estimates from hazardous waste sites. Baseline-emission estimates (BEEs) are defined as emission rates estimated for a site in its undisturbed state. Specifically, the manual is intended to: Present a protocol for selecting the appropriate level of effort to characterize baseline air emissions; Assist site managers in designing an approach for BEEs; Describe useful technologies for developing site-specific baseline emission estimates (BEEs); Help site managers select the appropriate technologies for generating site-specific BEEs.

43459 (PB–89-180061/XAB) **Air/Superfund national technical guidance study series, Volume 3. Estimation of air emissions from cleanup activities at Superfund sites. Interim report (Final).** Radian Corp., Austin, TX (USA). Jan 1989. 249p. Available from NTIS, PC A11/MF A01.

See also PB–89-180053.

This manual was developed concurrently with three related manuals that also address air issues arising from hazardous-waste sites. The overall goal of the program is to develop guidelines for predicting and/or measuring air emissions during remedial activities. For the preliminary version of the manual, the objectives were to: Present a protocol for estimating air emissions from remedial activities at NPL sites; Identify existing data gaps or limitations in the protocol; Provide guidance for collecting data to estimate or confirm air emissions. Field studies are scheduled to address one of the data gaps that has been identified. A revised version of the manual will be published subsequent to the research.

43460 (PB–89-182414/XAB) **Superfund Record of Decision (EPA Region 7): Times Beach, St. Louis County, Missouri. Minker/Stout/Romaine Creek, Jefferson County, Missouri (third remedial action), September 1988. Final report.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. 29 Sep 1988. 282p. (EPA/ROD/R–07-88/016). Available from NTIS, PC A13/MF A01.

See also PB–88-173000.

The Minker/Stout/Romaine Creek (M/S/RC) site is located in the city of Imperial, Jefferson County, Missouri, 25 miles southwest of St. Louis. The site is an unincorporated, wooded residential area and is comprised of four noncontiguous areas: Minker, Stout, Cashel, and Sullins. It is within a distance of approximately 0.8 miles and includes the upper 6000 feet of Romaine Creek. Contamination at the site resulted from the use of dioxin-contaminated soil as fill material, and has spread as a result of erosion from these areas. Contaminated soil in all areas except the Stout area and Romaine Creek has been excavated and currently is stored in interim onsite storage. The total volume of contaminated soil at this site including the amount in temporary storage is estimated to be 12,000 cubic yards. The primary contaminant of concern affecting the soil at this site is 2,3,7,8-TCDD (dioxin).

43461 (PB–89-188718/XAB) **Superfund Record of Decision (EPA Region 7): John Deere DDubuque Works, Dubuque, Iowa (first remedial action), September 1988. Final report.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. 29 Sep 1988. 50p. (EPA/ROD/R–07-88/021). Available from NTIS, PC A03/MF A01.

The John Deere Dubuque Works site is located approximately 2.5 miles north of the City of Dubuque, Iowa. The site is owned by Deere and Company, which has operated a manufacturing plant at the site since 1946. The plant property includes an area of 1,447 acres located in the flood plain at the confluence of the Little Maquoketa River and the Mississippi River. The waste-management history of the plant is complex, but the primary area of concern is an unlined landfill originally placed in a natural depression caused by the Little Maquoketa River. Prior to 1968, wastes were placed in the low areas of the landfill and combustible materials were burned. Another area of concern at the facility is the site of a 1980, 200,000-gallon diesel fuel spill. Investigations conducted by John Deere indicated that human health hazards at the landfill could be considered minimal with the primary hazard being the possibility of dissolved organic chemicals impacting offsite domestic wells located east of the plant along the Mississippi River. The primary contaminants of concern affecting the ground water are volatile organic compounds including benzene, PCE, TCE, and toluene. The selected remedial action for the site is included.

43462 (PB–89-188817/XAB) **Superfund Record of Decision (EPA Region 6): Koppers Texarkana Site, Texarkana, Texas (first remedial action), September 1988.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. 23 Sep 1988. 89p. (EPA/ROD/R–06-88/023). Available from NTIS, PC A05/MF A01.

Portions of this document are not fully legible.

The Koppers Texarkana site is located within the City of Texarkana, Texas. The site consists of a 34-acre residential area and a 28-acre former sand and gravel operation. The Koppers Company operated the site as a wood-preserving facility from 1910 to 1961 using pentachlorophenol (PCP), creosote, and metallic salts in the operation. The site is currently owned by Carver Terrace, Inc. The Texas Department of Water Resources became aware of the site in 1979 through the Ekhardt Survey. The remedial investigation indicated that the highest concentration of site contaminants in the soil were located near the operations and drip track areas of the old wood-preserving facility. The primary contaminants of concern affecting the soil, ground water, and sediments are volatile organic compounds including benzene, xylenes, and toluene, other organics including polynuclear aromatic hydrocarbons and PCP, and metals including arsenic. The selected remedial action for the site is included.

43463 (PB–89-189526/XAB) **Superfund Record of Decision (EPA Region 5): IMC East Plant, Terre Haute, Indiana site (IMC) (second remedial action), June 1988. Final report.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. Jun 1988. 80p. (EPA/ROD/R–05-88/070). Available from NTIS, PC A05/MF A01.

The IMC/Terre Haute site is located in southeastern Terre Haute, Vigo County, Indiana. A waste-disposal area, encompassing approximately six acres, is located in the northeastern portion of the plant site. From 1946 to 1954 a small facility on a six-acre segment of the property manufactured, packaged, and warehoused technical-grade benzene hexachloride (BHC-tech). In 1980, approximately 28,500 cu yds of soil, rubble, piping and other debris were excavated and placed in a secure clay-capped mound to prevent offsite migration of BHC-tech. The cap system included a surface drainage collection system and soil-gas venting. The selected remedial action for this site is no further action with a maintenance program.

43464 (PB–89-190821/XAB) **Guide to treatment technologies for hazardous wastes at Superfund sites.** Environmental Protection Agency, Washington, DC (USA). Office of Environmental Engineering and Technology. Mar 1989. 31p. (EPA–540/2-89/052). Available from NTIS, PC A03/MF A01.

Also available from Supt. of Docs. See also PB–88-113360.

This guidebook addresses alternative technologies that can be used to treat wastes at Superfund sites. These treatment methods comprise the following five sections of the alternative technologies table: Biological treatment; Chemical treatment; Physical treatment; Stabilization, solidification, and encapsulation treatment; and Thermal treatment.

43465 (PB–89-861850/XAB) **Wetlands legislation and management. January 1977-January 1988 (Citations from the Selected Water Resources Abstracts data base). Report for January 1977-January 1988.** National Technical Information Service, Springfield, VA (USA). May 1989. 186p. Available from NTISPC N01/MF N01.

See also PB–89-861868.

This bibliography contains citations concerning Federal and state legislation governing coastal and fresh-water wetlands. Studies of regional regulations and management of specific cites are included. Reconciling environmental considerations with economic pressures and landowners' rights is discussed. Wetlands restoration projects, conservation projects, and development plans are presented. Many citations discuss wetlands management and law in relation to the Clean Water Act. (This updated bibliography contains 351 citations, none of which are new entries to the previous edition.)

43466 (PB–89-861868/XAB) **Wetlands legislation and management. February 1988-May 1989 (Citations from the Selected Water Resources Abstracts data base). Report for February 1988-May 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 41p. Available from NTISPC N01/MF N01.

Supersedes PB–88-857560. See also PB–89-861850.

This bibliography contains citations concerning Federal and state legislation governing coastal and fresh-water wetlands. Studies of regional regulations and management of specific cites are included. Reconciling environmental considerations with economic pressures and landowners' rights is discussed. Wetlands restoration projects, conservation projects, and development plans are presented. Many citations discuss wetlands management and law in relation to the Clean Water Act. (This updated bibliography contains 50 citations, all of which are new entries to the previous edition.)

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

Refer also to citation(s) 41813, 41814, 41815, 41816, 41817, 41818, 41819, 41820, 41821, 41822, 41823, 41824, 43324

43467 (ACUNS–8701, pp. 50-74) **Marine processes.** Baker, J.M.; Angel, M.V. Association of Canadian Universities for Northern Studies (ACUNS), Ottawa, ON (Canada). 1987. (CONF-8508276–: Arctic heritage, Banff (Canada), 24-28 Aug 1985; MICROLOG–87-03004). In *Arctic heritage. Proceedings of a symposium.* Available from Association of Canadian Universities for Northern Studies, 130 Albert Street, Ottawa, ON, CAN K1P 5G4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Arctic Ocean is large Mediterranean-type sea 53% of which is occupied by water of shelf depth or less. Within this ocean are many potential hydrocarbon basins, and petroleum industry activity is developing rapidly. Risks of accidents due to environmental hazards are particularly high, and oil spills appear to be an immediate serious threat to Arctic ecosystems. This review of marine processes in the Arctic Ocean considers the possible effects of oil industry activities throughout. A discussion of the regional hydrography reveals relatively little exchange with other oceans, relatively little seasonal reduction in the area of pack ice, a major hydrographic influence of freshwater inputs, and that sea ice is the major hazard in oil drilling operations. Examination of sediment processes indicates interactions with various oil exploration activities, such as dredging and construction of artificial islands. The hydrology, low nutrient supply, stable density structure and inhibiton of wind mixing of surface layers all contribute to a relatively low nutrient content in the Arctic Ocean; this may be enriched locally by human activities such as dredging, sewage disposal, degradation of oil from spills, and spent drilling fluids. An important concern is whether the low nutrient levels are a limiting factor for natural degradation of spilt oil. In an analysis of Arctic energy flows, it is seen that food chains are short and simple, mean productivity and biomass are low, and there are large seasonal fluctuations. Effects of oil industry activity on these ecosystems are outlined, and pollutant effects, pathways and

sinks are discussed, with particular consideration to treatment of Arctic oil spills. Areas of needed research are proposed. 46 refs., 5 figs., 2 tabs.

43468 (AD-A-206295/8/XAB) **Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic). Biological report.** Hales, L.S.; Avyle, M.J.V.D. Georgia Cooperative Fishery and Wildlife Research Unit, Athens, GA (USA). Jan 1989. 33p. Available from NTIS, PC A03/MF A01.

Species profiles are literature summaries of the life history, distribution, and environmental requirements of coastal fishes and invertebrates. Profiles are prepared to assist with environmental-impact assessment. The spot (Leiostomus xanthurus) is an abundant fish in coastal waters of the South Atlantic Region. It is important to commercial and recreational fisheries. In the South Atlantic Region, spot spawn offshore from October to March. The larvae are transported from the offshore spawning grounds to estuarine nursery areas. Juvenile spot initially congregate in shallow tidal creeks, but then disperse into deeper water as they get larger. Spot mature at 2-3 years of age. As larvae, spot feed on plankton, but switch to benthic invertebrates as juveniles and adults. Juvenile and adult spot are eaten by many other fishes. Tolerance to thermal shock and other environmental extremes varies with developmental stage. Alterations of the salinity or temperature regimes of an estuary may affect populations of spot; disturbances that affect the benthic community upon which spot feed may also affect spot abundance. Spot are not strong swimmers and may, therefore, suffer significant mortality due to intake structures at industrial or power generation plants.

43469 (EC/IWD-87-128) **Mean monthly runoff estimation at ungauged sites using the square grid technique.** Pol, R.A. Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1987. 82p. (MICROLOG-87-06107). Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The square grid technique has been used in the past for assessing water resource potential as well as for planning hydrometric networks. The method can be extended to generate synthetic streamflow on ungauged streams. The technique was developed initially for obtaining co-ordinated maps of precipitation, evaporation and runoff on a long-term mean annual basis. The technique was extended to the estimation of the same hydrological elements on a monthly basis. This paper presents the application of the square grid technique to the estimation of mean monthly runoff in a pilot area in Nova Scotia. The pilot area chosen was the location of a proposed gas pipeline in anticipation of future data needs for ungauged locations along the proposed route. The square grid model is calibrated for eight hydrometric basins within the study area and verified and assessed on three gauged basins. This system can be used to store, process and retrieve information and may have numerous applications in the field of hydrology. The square grid computer program was purchased by the Water Resources Branch, Ottawa, and details needed to run the routines were not included. As part of this project it became necessary to expand on the consultant's documentation, hence, a section on program input files is included in the main test. 6 refs., 2 figs., 6 tabs.

43470 (OME/APIOS-1987) **Acid sensitivity of lakes in Ontario.** Ontario Ministry of the Environment, Toronto, ON (Canada). Acid Precipitation in Ontario Study. 1987. 26p. (In English and French). (MICROLOG-87-04680). Available from Ontario. Ministry of the Environment. A.P.I.O.S. Coordination Office, 40 St. Clair Avenue West, 7th Floor, Toronto, ON, CAN M4V 1M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Ontario Ministry of the Environment conducts surveys to determine the sensitivity of Ontario lakes to acidic precipitation. This report presents a summary of the latest results of this survey and includes information on 6,063 lakes throughout the province. Lakes are arranged alphabetically by county or district, and a sensitivity index on a scale of 1 to 5 is given for each lake sampled. A summary table shows that 25.4% of the lakes were found to be not sensitive to acidification, and a further 17% had low sensitivity. Four percent were classified as acidic and 15.4% as extremely sensitive. 1 tab.

43471 (PB-89-168793/XAB) **Population model for Alaska Peninsula sea otters. Final report.** Eberhardt, L.L.; Siniff, D.B. Minnesota Univ., Minneapolis, MN (USA). 31 Dec 1988. 106p. Available from NTIS, PC A06/MF A01.

This study was conducted to provide a basis for assessing risks of oil spills to sea otter populations along the Alaska Peninsula. The principal efforts were devoted to analyzing the available data on population dynamics. Curves characterizing survivorship and reproduction for sea otters were devised and fitted to several data sets. A detailed review was conducted of methods of assessing population dynamics data, and several new techniques (e.g., bootstrapping) were applied to available data. A simplified model for use with Alaska Peninsula sea otter populations was devised and implemented in a 'spreadsheet' format. Various aspects of model development and data on population size in Alaska Peninsula areas were reviewed.

43472 (PB-89-172654/XAB) **Southwest Florida shelf ecosystems study, 1987.** Environmental Science and Engineering, Inc., Gainesville, FL (USA). Jun 1987. 1846p. Available from NTIS, PC EE99/MF E99.

Set includes PB-89-172662 through PB-89-172696. See also PB-86-245768.

This set contains 4 volumes pertaining to the ecosystems of the southwest Florida shelf. It discusses the environmental study of the shelf, and the objective is to determine the potential impact of OCS oil and gas offshore activities on the aquatic system. Other individual documents are also available.

43473 (PB-89-172662/XAB) **Southwest Florida shelf ecosystems study, Volume 1: Executive summary.** Environmental Science and Engineering, Inc., Gainesville, FL (USA). Apr 1987. 77p. Available from NTIS, PC A05/MF A01.

See also Volume 2, PB-89-172670; Also available in set of 4 reports PC E99, PB-89-172654.

The 6-year Southwest Florida Shelf Ecosystems Program began in 1980 as an interdisciplinary study. The study area extends seaward from the west coast of Florida to the 200-meter isobath and from 27°N latitude southward to the Florida Keys and Dry Tortugas. The region includes Florida Bay but not other estuarine areas. This area contains numerous live-bottom habitats and associated communities in a complex, patchy matrix. Live-bottom areas are often separated by wide expanses of sand or mud bottom areas. This report concludes the 6-year Southwest Florida Shelf Ecosystems Program's environmental study. The ultimate objective of the program was to determine the potential impact of OCS oil and gas offshore activities on live-bottom habitats and communities, which are integral components of the southwest Florida shelf ecosystems.

43474 (PB-89-172670/XAB) **Southwest Florida shelf ecosystems study, Volume 2: data synthesis report.** Environmental Science and Engineering, Inc., Gainesville, FL (USA). Apr 1987. 372p. Available from NTIS, PC A16/MF A01.

See also Volume 1, PB-89-172662 and Volume 3 Part A, PB-89-172688; Also available in set of 4 reports PC E99, PB-89-172654.

The 6-year Southwest Florida Shelf Ecosystems Program began in 1980 as an interdisciplinary study. This report concludes the environmental study. The ultimate objective of the program was to determine the potential impact of OCS oil and gas offshore activities on live-bottom habitats and communities, which are integral components of the southwest Florida shelf ecosystems. Subsections provide a brief description of the study area and a brief history of the 6-year program. Subsequent sections of the report present Year 6 data collection and management methods, study area characterization, impact projections, conclusions, and references cited.

43475 (PB-89-172688/XAB) **Southwest Florida shelf ecosystems study, Volume 3: annotated bibliography. Part a (A-K).** Environmental Science and Engineering, Inc., Gainesville, FL (USA). Jun 1987. 677p. Available from NTIS, PC A99/MF E04.

See also Volume 2, PB-89-172670 and Volume 3, Part B, PB-89-172696.; Also available in set of 4 reports PC E99, PB-89-172654.

The objective of the Southwest Florida Shelf Ecosystems Study was to synthesize all field data (collected during the 5-year field study) and data from other sources in order to produce a concise, coherent description of the biota conditions and processes in the study area. The objective was to assure that all available data were identified and considered before final assessments were made, and that any differences or data gaps were identified before development plans were approved or finalized. The information-collection task of the Year 6 study was implemented to meet this final objective. The methods used in the information collection effort and a copy of the bibliography that resulted from this effort are presented in the volume (Part B). The synthesis methods and the results of the synthesis effort are described in Volumes I (Executive Summary) and II (Synthesis Report).

43476 (PB–89-172696/XAB) **Southwest Florida shelf ecosystems study, Volume 3: annotated bibliography. Part b (L-Z).** Environmental Science and Engineering, Inc., Gainesville, FL (USA). Jun 1987. 720p. Available from NTIS, PC A99/MF E04.

See also Volume 3 Part A, PB–89-172688; Also available in set of 4 reports PC E99, PB–89-172654.

The objective of the Southwest Florida Shelf Ecosystems Study was to synthesize all field data and data from other sources in order to produce a concise, coherent description of the biota conditions and processes in the study area. This information, although critical to the program, was somewhat limited in value to decision makers because of its sheer volume. Consequently, the objective of the Year 6 study was to summarize, interpret, and synthesize this large data set to provide detailed descriptions of the systems and processes on the Florida shelf, and use this information to assess potential impacts of offshore development that can be directly used for stipulations and guidelines for developing Florida's offshore resources. The information collection task of the Year 6 study was implemented to meet this final objective. The methods used in the information-collection effort and a copy of the bibliography that resulted from this effort are presented in the volume (Part A). The synthesis methods and the results of the synthesis effort are described in Volumes I (Executive Summary) and II (Synthesis Report).

43477 (SE/APC–39) **Sensitivity of Saskatchewan surface waters to acidic inputs.** Lechner, L.J.; Howard, G.L. Saskatchewan Environment, SK (Canada). Air Pollution Control Branch. 1987. 18p. (MICROLOG–87-02101). Available from Saskatchewan. Saskatchewan Environment & Public Safety, 3085 Albert St., Regina, SK, CAN S4S 0B1; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An overview of the sensitivity of lakes in Saskatchewan to acidic deposition is presented, based upon criteria developed for alkalinity and calcium. Highly sensitive lakes are defined by the criteria as having an alkalinity value of less than 10 (mg/l) or a calcium value of less than 4 mg/l. Moderately sensitive lakes are defined as having an alkalinity value between 10 and 20 mg/l, or a calcium value between 4 and 8 mg/l. The lower of the median calcium or median alkalinity value is used to determine a lake's sensitivity classification. Using these criteria, it was determined that generally, lakes on the Precambrian Shield area of northern Saskatchewan are classified as being either moderately or highly sensitive. The rest of Saskatchewan is well buffered against acid rain effects. 8 refs., 5 tabs.

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Refer also to citation(s) 41469, 41553, 41560, 41566, 41567, 41568, 41569, 41570, 41579, 41585, 41586, 41748, 41762, 41763, 42239, 42339, 42340, 42358, 42375, 43262, 43356, 43391, 43423, 43426, 43434, 43435, 43438, 43439, 43628, 43629, 43647, 43648

43478 (AD-A–205290/0/XAB) **Sampling, testing, and test interpretation of dredged material proposed for unconfined, open-water disposal in Central Puget Sound. Volume 5. Evaluation procedures technical appendix. Phase 1. Final report.** Phillips, K.; Jamison, D.; Malek, J.; Ross, B.; Krueger, C. Evaluation Procedures Work Group, Seattle, WA (USA). Jun 1988. 487p. Available from NTIS, PC A21/MF A01.

This final environmental impact statement evaluates alternatives considered in identifying preferred sites for disposal of dredged material in Central Puget Sound. Three public multi-user disposal sites (Commencement Bay, Elliott Bay, and Port Gardner) are indentified for use based on a site-selection process that considered several alternative sites. Alternative biological-effects conditions for site management were considered and a site condition identified for purposes of dredged material management at the Phase I sites.

43479 (AD-A–206274/3/XAB) **Preliminary assessment/site investigation: Tooele Army Depot, Utah. Volume 1. North Area and facilities at Hill Air Force Base. Final technical report, 1 September 1985-1 November 1987.** Lapins, A.; McConnell, L.; Porter, T. EA Engineering, Science, and Technology, Inc., Sparks, MD (USA). 12 Dec 1988. 208p. (AE-TLA–51E5-VOL-1). Available from NTIS, PC A10/MF A01.

See also Volume 1, Appendixes, AD-A206 275.

This report documents the Preliminary Assessment/Site Investigation (PA/SI) phase of the U.S. Army Installation Restoration Program for the North Area of Tooele Army Depot (N-TEAD), Utah. The PA/SI for N-TEAD involved the performance of a records search and the development and implementation of a field-sampling and analysis program. The objectives of the PA/SI were to: (1) identify sites at N-TEAD used to store, process, and/or dispose of hazardous waste; (2) determine which of these sites have a low potential for environmental contamination and/or pose no immediate apparent threat to public health and welfare; (3) determine which sites have a high potential for environmental contamination and/or pose a threat to public health and welfare; (4) perform limited sampling of soil, ground water, and/or surface water to determine existence of contamination, if any, and to evaluate potential for offsite migration; and (5) identify off-post sites that may be impacting the environment of N-TEAD.

43480 (AD-A–206275/0/XAB) **Preliminary assessment/site investigation: Tooele Army Depot, Utah. Volume 1. North Area and facilities at Hill Air Force Base. Appendixes. Final report.** EA Engineering, Science, and Technology, Inc., Sparks, MD (USA). Dec 1988. 219p. (EA-THA–51E5-VOL-1-APP). Available from NTIS, PC A10/MF A01.

See also Volume 2, AD-A206 276.

Results are presented of analysis of two water samples from Tooele Army Depot. The samples were received January 18, 1986. Table 1 contains the results for the samples as well as the method blank and three control spikes analyzed with the lot. Table 2 contains data that will be needed to enter the results into the USATHAMA data-management system. All parameters analyzed for Tooele and Lake City are listed in Table 2, so some parameters may be listed that were not required on the samples. Copies of all control charts for the analyses performed are enclosed as well as comments from review of the charts.

43481 (AD-A–206277/6/XAB) **Preliminary assessment/site investigation, Tooele Army Depot, Utah. Volume 2. South Area. Appendixes. Final report.** EA Engineering, Science, and Technology, Inc., Sparks, MD (USA). Dec 1988. 125p. (EA-THA–51E5-VOL-2-APP). Available from NTIS, PC A06/MF A01.

See also Volume 1, AD-A206 274.

Results of analysis of two water samples from Tooele Army Depot are presented. The samples were received January 18,1986. Table 1 contains the results for the samples as well as the method blank and three control spikes analyzed with the lot. Table 2 contains data that will be needed to enter the results into USATHAMA data management system. All parameters analyzed for Tooele and Lake City are listed in Table 2, so some parameters may be listed that were not required on the samples. Copies are enclosed of all control charts for the analyses performed as well as comments from review of the charts.

43482 (AD-A–206661/1/XAB) **Long-term effects of dredging operations program: preliminary recommendations for a congener-specific PCB (polychlorinated biphenyl) analysis in regulatory evaluation of dredged material. Final report.** Clarke, J.U.; McFarland, V.A.; Pierce, B.D. Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab. Feb

1989. 41p. (WES/MP/D–89-2). Available from NTIS, PC A03/MF A01.

A preliminary recommendation of priority polychlorinated biphenyl (PCB) congeners for congener-specific analysis is offered for use in the regulatory evaluation of dredged material. Potential toxicity, environmental prevalence, and relative abundance in animal tissues are the criteria used in the selection of specific congeners and their assignment to four priority groups. Potential toxicity is equated to mammalian microsomal mixed-function oxidase (MFO) induction activity and type. MC- (3-methylcholanthrene-)-type and mixed-type induction activities are considered potentially most toxic, followed by PB- (phenobarbital-) type induction activity. Weak inducers and non-inducing congeners have the least potential for toxicity. Environmental prevalence, i.e., frequency of occurrence of specific congeners in environmental samples, is determined from the literature. Relative abundances of congeners (percents of total PCB as the sum of all congener concentrations) in tissues are reported or calculated from data in the literature, along with data generated from an experiment conducted at the US Army Engineer Waterways Experiment Station.

43483 (AD-A–206957/3/XAB) **Evaluation of dredged material disposal alternatives for US Navy homeport at Everett, Washington. Final report.** Palermo, M.R.; Shafer, R.A.; Brannon, J.M.; Myers, T.E.; Truitt, C.L. Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab. Jan 1989. 354p. (WES/TR/EL–89-1). Available from NTIS, PC A16/MF A01.

The US Navy has proposed to homeport a carrier battle group at Everett, Wash. Development of the homeport will involve dredging and disposal of approximately 1 million cu yd of contaminated native material. The US Army Engineer District, Seattle, is providing technical assistance in developing a dredging and disposal plan for these sediments from the East Waterway. In addition, the Seattle District is a permitting agency under Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act. The purpose of the WES studies was to evaluate the feasibility of alternatives from an environmental and related engineering standpoint. Three major disposal alternatives were evaluated for disposal of the contaminated sediment: confined upland, confined nearshore, and contained aquatic disposal (CAD). The Navy identified CAD as a preferred alternative during the course of the WES study, and also as the selected alternative in all applications for a Section 404 permit.

43484 (AD-A–207045/6/XAB) **New Bedford Harbor Superfund Project, Acushnet River Estuary engineering feasibility study of dredging and dredged-material disposal alternatives. Report 3. Characterization and elutriate testing of Acushnet River Estuary sediment. Technical report, August 1985-March 1988.** Averett, D.E. Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab. Mar 1989. 54p. (WES/TR/EL–88-15-3). Available from NTIS, PC A04/MF A01.

See also Report 4 dated Jan 88, AD-A200 462.

Several of the alternatives being considered for the New Bedford Harbor Superfund Project involve dredging of contaminated sediment from the Acushnet River Estuary and placement of the contaminated dredged material in confined disposal areas. Evaluation of these alternatives requires testing sediment from the site to determine chemical and physical characteristics, settling properties, contaminant releases for various migration pathways, and treatment requirements for disposal area effluent. The purpose of this report is to describe the estuary composite sediment sample and the hot-spot-sediment sample tested at the US Army Engineer Waterways Experiment Station as part of the US Army Corps of Engineers' Acushnet River Estuary Engineering Feasibility Study of Dredging and Dredged Material Disposal Alternatives. Bulk sediment chemistry, physical characteristics, and elutriate testing for the sediments are included.

43485 (CPS–8702, pp. 201-221) **Development and demonstration of a mobile reverse osmosis/adsorption treatment system for environmental clean-ups.** Donison, H. (ZENON Environmental Inc., Burlington, ON, Canada); Whittaker, H.; Tremblay, J.; Dutton, R. Environnement Canada, Ottawa, ON (Canada). Conservation et Protection. 1987. (CONF-870295–: Technical seminar on chemical spills, Toronto (Canada), 9-12 Feb 1987; MICROLOG–87-01873). In *Proceedings [of the] 4th technical seminar on chemical spills.* Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A system for treatment of organically contaminated waters resulting from chemical spills or landfill leachates was develped and demonstrated. The treatment system consists of two primary unit operations. The organically contaminated water is processed by reverse osmosis to produce a clean stream for discharge and a stream for further processing in which the organic contaminants have been concentrated up to ten times the original concentration. The concentrated stream suitable for discharge. The ultimate result of treatment is that the contaminated water can be treated on-site to produce a dischargeable effluent and the organic contaminants can be removed from the site adsorbed on a relatively small amount of carbon for incineration or disposal at a secure landfill. The system was demonstrated for 60 days at two contaminated sites. At one site the system was used to treat water drained from areas where petroleum products had been spilled over a number of years. At the second site, leachate from a hazardous waste landfill containing a number of chlorinated and nonchlorinated solvents was treated. The results of the demonstrations showed that between 50 and 95 % removal can be achieved for organic contaminants present in the feed at low ppM levels or less by this treatment system. 6 refs., 7 figs., 4 tabs.

43486 (CPS–8702, pp. 333-341) **A computer model system for CERCLA [Comprehensive Environmental Response, Compensation, and Liability Act] type A damage assessments.** Reed, M. (Applied Science Associates, Narraganseth, RI, USA); French, D.; Grigalunas, T.; Opaluch, J. Environment Canada, Ottawa, ON (Canada). Conservation and Protection. 1987. (CONF-870295–: Technical seminar on chemical spills, Toronto (Canada), 9-12 Feb 1987; MICROLOG–87-01873). In *Proceedings [of the] 4th technical seminar on chemical spills.* Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A coupled marine transport/biological injury/economic damages model system has been developed to serve as the proposed basis for type A (small scale) damage assessments under the 1980 comprehensive Environmental Response, Compensaton, and Liability Act (CERCLA). The model, which operates on a personal computer, relies on large chemical and biological data bases for fundamental parameters. Spilled material concentrations are computed dynamically on the water surface, in the upper and lower water column, and in the sediments. Biological losses due to direct toxic effects on adults, and future catch reductions due to losses of larvae and juveniles, are calculated for commercially important species. Losses resulting from primary and secondary productivity are included through a simple fractional rule for energy transfer efficiency up the food chain. 1 ref., 3 figs., 1 tab.

43487 (EC/WQB–87-121) **An assessment of LRTAP acidification of surface waters in Atlantic Canada.** Howell, G.D.; Brooksbank, P. Environment Canada, Ottawa, ON (Canada). Water Quality Branch. [1989]. 313p. (MICROLOG–87-02938). Available from Water Quality Branch, Inland Waters Directorate, ATT: John Temple, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7;MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report analyses lake and river water quality data from Atlantic Canada in an attempt to provide a regional overview of the terrain sensitivity and the extent of long-range transport of atmospheric pollutant (LRTAP) induced acidification. Southwestern Nova Scotia, northern Cape Breton Island and the west and south coast of Newfoundland have been identified as the areas which are the most sensitive to acidification. Surface waters in these areas show signs of acidification resulting from the combined effects of acid loadings from natural (i.e. organic acids) and anthropogenic (LRTAP) sources. Lake sulphate concentrations generally reflect the west to east deposition gradient with the highest values observed in New Brunswick and southwestern Nova Scotia. The most extreme

acidification has occurred in Nova Scotia, with many of the hydrometric basins having lost on average more than 80 percent of the pre-acidification alkalinity. This is reflected in the pH data with 45% and 15% of the Nova Scotia lakes having values below 5.3 and 5.0 respectively. Analysis of temporal changes indicated that pH values in Nova Scotia and Newfoundland rivers were significantly lower during the late 1960's and early 1970's while hydrogen ion exports peaked in 1973. This pattern agrees with the temporal pattern observed for the sulfur emissions in both the USA and eastern Canada. 58 refs., 97 figs., 18tabs.

43488 (EPRI-EN–6405) **Estimates of macrodispersivity based on analyses of hydraulic conductivity variability at the MADE [Microdispersion Experiment] site: Interim report.** Waldrop, W.R. Electric Power Research Inst., Palo Alto, CA (USA); Tennessee Valley Authority, Norris, TN (USA). Engineering Lab.; Massachusetts Inst. of Tech., Cambridge, MA (USA). Dept. of Civil Engineering. c Jul 1989. 164p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

At the site of an ongoing large-scale tracer experiment on the Columbus Air Force Base (CAFB), Mississippi, the feasibility of estimating the autocovariance parameters of log conductivity from variability measurements and of predicting the asymptotic macrodispersivities using recent stochastic theories is demonstrated. Extensive measurements of the hydraulic conductivity (K) in three dimensions, obtained using a borehole flowmeter method, were analyzed in detail to estimate the parameters of the lnK covariance. Special emphasis was placed on estimating the uncertainty in the parameter values due to finite data sets, measurement errors, and nonstationarity. A pragmatic methodology was developed based on the uncertainty in covariance parameter estimates and observed site characteristics to assess whether the random field contains a trend and how to decide on the appropriate level of detrending. The uncertainty in the parameter estimates yields a range of parameter values that encompassed the case of a second order trend removed by ordinary least squares methods, which was analyzed for the effects of correlated residuals and variogram bias. Covariance parameter estimates from preliminary analyses of secondary measurements such as surface geophysical surveys, grain size data, and large-scale aquifer tests were generally within the uncertainty from the extensive measurements suggesting the possibility that the covariance parameters can be estimated without exhaustive sampling. Most likely and bounding values of the covariance parameter were used to predict a range of macrodispersivities. A comparison of the predicted macrodispersivities to the measured values from the ongoing large- scale tracer experiment at CAFB cannot be made until the tracer test is complete. 76 refs., 40 figs., 19 tabs.

43489 (ETDE-mf–9911036) **Studies on the influence of foreign ions on the calcium carbonate precipitation under conditions of water heating. Final report.** Hoelzel, G. Fachhochschule Braunschweig-Wolfenbuettel, Wolfenbuettel (Germany, F.R.). Fachbereich Versorgungstechnik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Dec 1988. 157p. (In German). Contract BMFT 02-WT85465. Order Number DE89911036/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01.

Measuring was necessary to determine the hitherto inadequately known solubility product of calcium carbonate in the temperature range between 10^0C and 80^0C in the presence of foreign ions; this was done to make exact predictions about the calcium carbonate precipitation during the process of water heating. The results showed that the approach of Plummer and Busenberg covers the solubility equilibrium over the complete temperature range from 10^0C and 80^0C, if, following a proposal by Eberle, complex ions are taken into consideration. In order to make quantitative predictions over a maximum calcium carbonate precipitation possible, a calcium carbonate precipitation potential was defined. (orig.) With 28 refs., 8 tabs., 10 figs.

43490 (GKSS–88/E/70) **Influence of suspended particulate matter regime on the heavy metal pollution of the tidal river Elbe at Hamburg.** Irmer, U.; Knauth, H.D.; Weiler, K. GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). 1988. 7p. (In German). Available from Special print from Z. Wasser Abwasser Forsch. (1988) v. 21 p. 236-240.

In monitoring programmes heavy metal contents of flowing water usually are determined as total concentrations. Particularly in tidal rivers characterized by conspicuous changes of suspended particulate matter (SPM) contents, an assessment of the pollution of different areas and in time series could only be achieved by separate analysis of 'dissolved' and seston bounded heavy metal concentrations. As a result of the investigations, analysis of the heavy metal contents of SPM showed that tbe monitoring strategy used is suitable to prove the influence of SPM regime on the area and the time (saison) dependent specific variability of heavy metal pollution in the widely branched tidal river Elbe at Hamburg. (orig.).

43491 (OME/WRB–8704) **Contaminant concentrations in bottom sediments of the Sir Adam Beck power reservoir and Niagara River bar dredgeate.** Kauss, P.B.; Post, L.E. Ontario Ministry of the Environment, Toronto, ON (Canada). Water Resources Branch. 1987. 49p. (MICROLOG–87-06345). Available from Ontario Ministry of the Environment, Public Information Office, 135 St. Clair Ave. West, Toronto, ON, CAN M4V 1P5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In November 1983, a survey was conducted to determine the concentration and distribution of contaminants in sediments of Ontario Hydro's Sir Adam Beck Power Reservoir and the concentration of contaminants in material commercially dredged from the Niagara Bar at the outlet of the Niagara River. Samples were analyzed for inorganics, solvent extractables (oils and greases), polychlorinated biphenyls (PCBs), organochlorine pesticides, nutrients, percent loss on ignition and sediment particle size distribution. Bottom sediments in the reservoir contained levels of certain metals at levels in excess of provincial guidelines. These findings suggest either relatively recent or ongoing upstream inputs of particulate-associated contaminants, since the latter were identified in surficial layers. Due to the nature of water withdrawals for hydropower generation, the contaminants probably originated mainly in the Chippawa Channel and reached the reservoir via the Chippawa-Grass Island Pool diversion. PCBs were also detected in 43% of the samples from the reservoir, but at levels close to the detection limit and below the disposal guideline. Samples from the Niagara Bar contained solvent extractables, nutrients, inorganics, and organochlorines at concentrations which were considerably below guidelines for open water dredge spoil disposal and, in most instances, lower than in fresh surficial sediments from the Bar. Since the latter contained some contaminants at levels above dredging guidelines (such as PCBs and Fe), there is a need to determine the impacts of possible particulate-associated contaminant losses during the dredging operation. Hexachlorobenzene was the only organochlorine compound detected in dredgeate samples. 24 refs 4 figs 8 tabs

43492 (PB–89-166607/XAB) **Assessment of the potential for transport of dioxins and codisposed materials to ground water. Report for 26 December 1986-25 January 1988.** Walters, R.W.; Yousefi, Z.; Tarleton, A.L.; Ostazeski, S.A.; Barry, D.C. Maryland Univ., College Park, MD (USA). Dept. of Civil Engineering. Mar 1989. 114p. Available from NTIS, PC A06/MF A01.

Dioxins are very toxic contaminants and warrant study under a variety of experimental conditions. Studies were performed to evaluate the mobility of several of the dioxins in both soil columns as well as in batch experiments. The studies showed that the amount of chlorination did not necessarily control the partitioning of the dioxins, as expected, but also suggested that the structure or location where the Cl ion was attached to the benzene ring modified the hydrophobicity of the compound. Studies were performed with a variety of cosolvents that might mediate the movement of the dioxin. The observed modification in mobility was consistent with existing theory for enhanced mobility with truly miscible solvents. Experimental data appear to show reversibility in the sorption process, but significantly limited by kinetics with 30 to 50 days required to release 50-90% of the contaminant.

43493 (PB–89-169791/XAB) **Numerical calculation of dispersion of constituents in estuaries and coastal seas.** van Stijn, T.L.; Praagman, N. Rijkswaterstaat, The Hague (Netherlands). Data

Processing Div. Feb 1988. 13p. (SWA–88/033). Available from NTIS, PC EE03/MF A01.

In the recent years the study of the environment has become increasingly important. This is a result of the present-day economic expansion, which brings about a tremendous pollution problem of ground and surface waters and of the atmosphere. It has become clear that it is a necessity to use adequate models in order to trace out the consequences of accidents in seas and in estuaries that lead to pollution of the waters. In this paper the authors discuss two numerical techniques that are particularly suited for the calculation of the transport of pollutants in realistic simulations. These methods are among the best in the resolution of sharp gradients on a relatively coarse grid, without generating significant negative concentrations. The outcome of a test with an exact solution are shown. Moreover, a result of a realistic application is given in the Dutch Keeten-Volkerak model by means of the operational WAQUA simulation model.

43494 (PB–89-171524/XAB) **Fiscal Year 1987 program report: Connecticut Institute of Water Resources.** Miller, D.R. Connecticut Univ., Storrs, CT (USA). Inst. of Water Resources. Oct 1988. 35p. Available from NTIS, PC A03/MF A01.

See also PB–88-161062.

Connecticut's Institute of Water Resources 1987-88 research and information transfer projects focused on water-quality management and protection, hydrologic cycle modeling, wetland restoration, acid precipitation, ground water, lake management, and water allocation. Funded research projects included: Design and testing of an interactive ground and surface-water hydrologic model (02); chemical and physical interactions of ground water organics and metals with soils (03); using scaled chrysophytes to infer changes in paleolimnological environments (04); evaluation of ground water flow using 'Down-Well/Down-Well' and 'Down-Well/Surface' resistivity techniques (05); and, design and testing of an improved method for electrochemical recovery of metals from waste water (06). Information-transfer conference topics included: wetlands and development compatibility issues, metal recovery from wastewater, lake management, aquifer protection, Geographical Information Service, and water allocation.

43495 (PB–89-175624/XAB) **Water-quality benefits from the Conservation Reserve Program.** Ribaudo, M.O. Economic Research Service, Washington, DC (USA). Resources and Technology Div. Feb 1989. 40p. (USDA/AER–606). Available from NTIS, PC A03/MF A01.

The Conservation Reserve Program, a land-retirement program designed to remove from production 40 to 45 million acres of highly erodible cropland, may generate an estimated $3.5 to $4 billion in water-quality benefits. Potential benefits include lower water-treatment costs, lower sediment removal costs, less flood damage, less damage to equipment that uses water, and increased recreational fishing. Benefits were estimated with a set of procedures that approximated the physical, chemical, biological, and economic links between soil erosion and water use.

43496 (PB–89-178578/XAB) **Light-sensitized decontamination of ground-water hazardous chemicals. Technical report (Final).** Larson, R.A.; Schlauch, M.B.; Ellis, D.D.; Marley, K.A.; Ju, H.L. Illinois Univ., Urbana, IL (USA). Environmental Research Labs. 1988. 30p. Available from NTIS, PC A03/MF A01.

The use of sunlight, oxygen, and dissolved organic compounds active as 'photosensitizers' (substances capable of absorbing sunlight and transforming it into chemically useful forms) is a promising treatment for contaminated waters. Light is absorbed by the sensitizing substance, raising it to a higher energy excited state. Reaction with the excited state substance converts molecular oxygen to a form much more reactive with dissolved compounds. Riboflavin (Vitamin B2), a naturally occurring compound and a known photosensitizer, was investigated for use in this process. A series of kinetic experiments explored its ability to photodegrade several aromatic compounds, phenols and anilines, that are related to some herbicides (such as carbaryl, 2, 4-D, alachlor, atrazine, and trifluralin) commonly found in polluted waters. It was found that riboflavin when added to solutions of phenols or anilines greatly accelerated the rate of their loss in the presence of light. The sensitized photolysis rates increased in the absence of oxygen, suggesting a mechanism involving direct energy or electron transfer between flavin excited states and acceptor molecules. In addition, it was found that some iron salts were very significant promoters of photodestruction of the triazine herbicide, atrazine.

43497 (PB–89-178602/XAB) **Novel two-stage three-phase fluidized-bed bioreactor with immobilized living cells for waste-water treatment application. Final report, September 1985-September 1988.** Fan, L.S. Ohio State Univ., Columbus, OH (USA). Dept. of Chemical Engineering. Oct 1988. 132p. Available from NTIS, PC A07/MF A01.

This research investigated the fundamental, practical design and operation of a novel two-stage three-phase fluidized-bed bioreactor for cost-effective waste-water treatment. Phenol biodegradation was selected as a model biodegradation system for the study. The fundamental studies included bubble wake structure and dynamics, solid mixing, gas-liquid mass transfer, biofilm characteristics, and biodegradation kinetics. Comprehensive mathematical models for steady state and dynamic phenol biodegradation in both draft tube and conventional three-phase fluidized bed bioreactors were developed and experimentally validated. These models provided guidelines for design, control and optimization of biodegradation, processes in three-phase fluidized bed bioreactors. The two-stage bioreactor was demonstrated to successfully integrate immobilization, biofilm development, biodegradation and biofilm control functions into one single unit with the least human intervention. The performance of the two-stage bioreactor in terms of biodegradation rate per unit solid loading was shown to be superior to that of a one-stage three-phase fluidized-bed bioreactor.

43498 (PB–89-180632/XAB) **National Benthic Surveillance Project: Pacific Coast, Part 1. Summary and overview of the results for cycles 1 to 3 (1984-86). Technical memo.** Varanasi, U.; Chan, S.L.; McCain, B.B.; Schiewe, M.H.; Clark, R.C. National Marine Fisheries Service, Seattle, WA (USA). Northwest and Alaska Fisheries Center. Dec 1988. 74p. (NOAA-TM-NMFS-F/NWC–156). Available from NTIS, PC A04/MF A01.

This report summarizes and interprets the results of the first 3 years of the Pacific Coast phase of the National Benthic Surveillance Project (NBSP), a component of NOAA's National Status and Trends Program. A comprehensive data base was developed, which includes detailed information on the distribution of a variety of chemical contaminants. These contaminants include selected aromatic hydrocarbons, PCBs, organochlorine insecticides and metals in surficial sediments and in liver tissue, bile, and stomach contents of selected bottom-feeding fish. The overall finding from the NBSP for the years 1984-86 indicated that the highest concentrations of most sediment-associated contaminants were present in the highly urbanized areas, and that contaminants were bioavailable to indigenous marine species.

43499 (PB–89-181945/XAB) **USEPA (United States Environmental Protection Agency) Method Study 38, SW-846, Method 3010: acid digestion of aqueous samples and extracts for total metals for analysis by flame atomic absorption spectroscopy. Final report, September 1986-February 1988.** Edgell, K.W.; Wilbers, D.M. Bionetics Corp., Cincinnati, OH (USA). Apr 1989. 178p. Available from NTIS, PC A09/MF A01.

An interlaboratory collaborative study was conducted to determine the mean recovery and precision for analyses of 21 trace metals in surface and waste waters. The study design was based upon Youden's non-replicate plan for collaborative tests of analytical methods. Four water matrices were spiked with 21 trace metals at six concentration levels, as three Youden pairs. Nine participating laboratories analyzed the four sample types using Method 3010. The primary objective was to use the USEPA computer program Interlaboratory Method Validation Study to measure recovery and precision for the 21 trace metals and compare the performance of the method across water types. Minimum detection limits (MDLs) were also compared. Comparison between samples, at the lowest metals concentration specified and another sample at 50% of those values, verified that the values specified in SW-846 are valid.

43500 (PB–89-183024/XAB) **Management functions for effective controls of ground-water contamination. Technical completion report.** Huang, J.Y.C. Wisconsin Univ., Madison, WI

(USA). Water Resources Center. 1988. 35p. (WIS-WRC–88-02). Available from NTIS, PC A03/MF A01.

Preventing ground-water pollution is the most desirable means of ensuring groundwater quality. The institutional framework of groundwater protection at the state and local levels of government was evaluated. Six southeastern Wisconsin counties were investigated through personal interviews with county health officials using a questionnaire designed to identify management practices, tools, and problems as well as local sources of ground-water pollution. Based on a nationwide assessment and responses to the county questionnaire, recommendations were made on an effective means of controlling ground-water contamination. The most difficult management problems were identified as political, indicative of the lack of local level government support of ground-water protection. Because government is responsive to public opinion, the lack of support is the result of a lack of public awareness. Thus, education should be an integral part of ground-water programs in order to gain support for protection efforts.

43501 (PB–89-183206/XAB) **Eutrophication and watershed study of Stoneville reservoir for the town of Auburn, Massachusetts. Final report.** Lycott Environmental Research, Inc., Southbridge, MA (USA). Jan 1981. 209p. Available from NTIS, PC A10/MF A01.

Outlines point-source pollution from Leicester liquid-waste disposal area that is degrading water-quality in Stoneville Reservoir, MA. Turbidity is the major water quality problem and is due to iron from a liquid waste site and landfill. Recommends settling pond to filter iron and manganese. The report was prepared in partial fulfillment of the requirements of an EPA Clean Lakes Program grant.

43502 (PB–89-191357/XAB) **Polluting incidents in and around US waters: calendar year, 1984, 1985 and 1986.** Coast Guard, Washington, DC (USA). Feb 1989. 91p. (USCG-COMDTINST-M–16450.2H). Available from NTIS, PC A05/MF A01.

Supersedes PB–87-186821.

This publication provides general information concerning pollution discharges into U.S. Navigable Waters for CY 1984 thru 1986. The data are presented in both tabular and graphic formats. The source of the data is the Pollution Incident Reporting System (PIRS), a computer-based system developed by the Coast Guard to support the Marine Environmental Response Program. PIRS contains data in addition to that published here.

43503 (PB–89-196679/XAB) **Superfund Record of Decision (EPA Region 9): Lorentz Barrel and Drum, San Jose, California (first remedial action), September 1988.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. 25 Sep 1988. 122p. (EPA/ROD/R–09-88/023). Available from NTIS, PC A06/MF A01.

The 5.4-acre Lorentz Barrel & Drum (LB and D) site is located in San Jose, California, about 0.25 mile from San Jose State University. The site lies directly above a major source of potable ground water in the south San Francisco Bay area, with three public water-supply-well fields within one mile of the site. In 1947 the Lorentz family began a drum-recycling operation on 10.5 acres of land at the site. Drums containing residual aqueous wastes, organic solvents, acids, oxidizers, caustic residues and oils were received for recycling. Sometime between 1968 and 1971 the discharge was diverted to a sanitary sewer, and investigations indicate that this discharge occurred until 1984. Since 1981 several investigations have revealed soil and ground water contaminated with numerous metals, organics, and PCBs. This remedial action will address the offsite contaminated shallow ground water. The selected Expedited Response Action for this site includes: onsite ground water pump and treatment using ozone/UV for organic removal and ion exchange for nickel removal, with discharge of treated water to a local creek.

43504 (PB–89-861892/XAB) **Waste-water treatment: lagoons. January 1977-May 1989 (Citations from the Selected Water Resources Abstracts data base). Report for January 1977-May 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 222p. Available from NTISPC N01/MF N01.

Supersedes PB–88-858626.

This bibliography contains citations concerning the treatment and storage of waste waters in lagoons. The design, operation, equipment, and pretreatment processes are discussed. The treatment of waste water from breweries, tanneries, paper mills, and other industrial operations are considered. Descriptions and evaluations of specific facilities are provided. (This updated bibliography contains 401 citations, 26 of which are new entries to the previous edition.)

43505 (PB–89-862916/XAB) **Waste water and water treatment: anion exchange. January 1977-May 1989 (Citations from the Selected Water Resources Abstracts data base). Report for January 1977-May 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 101p. Available from NTISPC N01/MF N01.

Supersedes PB–86-858297.

This bibliography contains citations concerning the theory, methods, and applications of anion exchange in the treatment of potable water and waste water. Topics include anion exchange resins and membranes, desalination techniques, and process evaluations. Methods for anion analysis using chromatographic techniques are also considered. (This updated bibliography contains 165 citations, 35 of which are new entries to the previous edition.)

5203 Radioactive Materials Monitoring and Transport

Refer also to citation(s) 41717, 41750, 41757, 42639, 42672, 42881, 43416

43506 (AECL–9506) **HYDROS: a model of radionuclide migration in surface waters.** Wilkinson, S.R. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Oct 1987. 13p. Order Number DE89635118/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The submodel HYDROS has been developed for the safety assessment code COSMOS-S/D to represent radionuclide migration in surface waters. Model assumptions are generally conservative (i.e. pessimistic) in keeping with the safety assessment philosophy. Dilution is the dominant mechanism for reducing contaminant concentration. Actual removal of contaminant occurs through delay and decay, evaporation (if volatile), or sorption in lake sediment, the latter modelled as an irreversible process. The same system of equations applies equally to both river reaches and lakes, with the difference apparent only in the relative effects of dispersion and delay mechanisms for a given radionuclide. Experience since the original model was developed has led to simplification of input so that the submodel is easier to use.

43507 (AECL–9520) **Dispersion of contaminants in saturated porous media. Validation of numerical models.** Moltyaner, G.L.; Poisson, J.M. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Oct 1987. 68p. Order Number DE89635119/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

The main objective of this paper is to outline the experimental and theoretical investigations performed in an attempt to validate the applicability of finite element based numerical models for the prediction of the behaviour of a conservative tracer at the Twin Lake aquifer, Chalk River Nuclear Laboratories, Chalk River, Ontario. The essential point is that the 3/4 of a million data points obtained at the Twin Lake site from a 40 m natural gradient tracer test provide a unique opportunity for quantifying the system variability and for testing finite element models of the dispersion process. The subject of this discussion is the advection-dispersion model of contaminant transport - its equation and solution by the Galerkin finite element method. The report gives a brief description of the experimental data and the methods for the estimation of transport parameters. Scales of averaging associated with the conceptual formulation of the dispersion process, measurement of process variables, parameter estimation and the numerical models are discussed. The compatibility between the scales is emphasized as a major requirement for predictive modelling. The developed finite element model of the radioiodine transport describes the overall behaviour of the tracer plume but lacks the capability to simulate the fingerlike spreading of the plume due to the fact that the grid does not have

an adequately fine space discretization. Unfortunately, a refinement of the grid spacing is limited by the size of the site computer memory. For the advection-dominated transport, as that encountered at the Twin Lake aquifer, the failure to satisfy fine mesh requirement causes numerical dispersion. (Abstract Truncated)

43508 (AECL–9521) **Method of moments analysis of the Twin Lake tracer test data.** Moltyaner, G.L.; Wills, C.A. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Sep 1987. 72p. Order Number DE89635120/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

The two-dimensional transport of radioiodine at the Twin Lake aquifer at CRNL, is investigated at the full-aquifer-thickness scale using curve fitting procedures and the method of statistical moments. The observed concentration-time data were analysed using temporal moments and were converted to concentration-distance data sets. The converted data were then analysed using spatial moments and curve fitting procedures. It was concluded that over the 40 m flow path the areal two-dimensional model of mean concentration distribution does not adequately describe the essentially three-dimensional nature of the dispersion process probably because of the relatively short travel distances compared to the full-aquifer-thickness scale of description of the transport process (~ 10 m). Much larger travel distances are required before the effect of irregular flow geometry at this scale is smoothed out. Based on the previous analysis of the dispersion process at the macroscopic scale of descriptions of the transport processes it was concluded that the macroscopic scale characteristics, to a large extent, possess a universal character and the macroscopic-scale dispersion model adequately describes the field-scale dispersion process. 20 refs.

43509 (EC-SS–156) **Radionuclide content of some Canadian surface waters: a report on the National Radionuclides Monitoring Program, 1981 - 1984.** Baweja, A.S.; Joshi, S.R.; Demayo, A. Department of the Environment, Ottawa, ON (Canada). Inland Waters Branch. 1987. 25p. Order Number DE89635121/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Water samples were analyzed for total U, Ra-226, Cs-137, Sb-125 and tritium. Levels are generally low, and no time trends were discernible during the monitoring period. Temporal variations among the quarterly analyses are mostly insignificant. Except for total U at certain locations, all other radionuclide levels were much below the 'target concentration' guidelines for Canadian drinking water. The main contribution to the radiological dose commitment was from total U and Ra-226. Contributions from individual radionuclides to cumulative dose were in the order: total U > Ra-226 > tritium > Cs-137 > Sb-125. The limited sediment data suggest that the nuclear facilities along the Ottawa River have increased the levels of Cs-137 and Co-60 but have not affected those of Pb-210 and Ra-226. Total U and Ra-226 activities data suggest disequilibrium; the levels of total U in water were much higher than those of Ra-226. Concentrations of the two radionuclides, however, were positively correlated for most surface waters.

43510 (EPS–3/PG/1) **Radioactivity in coal, ashes and selected wastewaters from Canadian coal-fired steam electric generating stations.** Environment Canada, Ottawa, ON (Canada). Environmental Protection Service. Sep 1985. 131p. Order Number DE89635122/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Coal is known to contain naturally occurring radioactive elements and there has been speculation that as a results, coal-fuelled power generation stations may be significant emitters of these substances. In this report, the subject of radioactivity is introduced. The kinds of radioactive substances which occur naturally in coal formations, the nature of their emissions and the existing information on their behaviour and their effects on environmental organisms are also reviewed. The results of an examination of levels of alpha, beta and gamma radiaton levels, and the substances which produce them in coals, fly ashes, bottom ashes and related wastewaters at six Canadian coal-fuelled power stations are presented. Difficulties in studies of this nature and the potential effects of these releases on organisms in the adjacent aquatic environment are discussed. Existing and potential technologies for the removal of these substances from wastewaters are examined. In general the releases in wastewaters from the six stations were found to be lower than those known to cause short-term or acute biological effects. The potential for long-term effects from such low-level releases could not be accurately assessed because of the paucity of information. A number of recommendations for: improvements in further studies of this nature; the further examination of the fate of naturally occurring radionuclides in the environment; and the determination of the long-term effects of low levels of naturally occurring radioactive substances on aquatic organisms, are made.

43511 (GSF-Hy–2/88) **Annual report 1987 of the GSF Institute of Hydrology.** Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Hydrologie. Jun 1988. 288p. (In German). Order Number DE89911042/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

The first chapter presents the studies and results on the migration of pollutants, covering radionuclide behaviour (Cs-134, C-14) in deeper pore aquifers in the area of the Gorleben site for ultimate radwaste disposal and in the Asse salt dome area, the fate of the Chernobyl fallout in the soil, and nitrate in quarternary gravel deposits, as well as mathematical models of sorption and desorption processes. The second chapter reports on work in selected areas, covering hydrogeological, glacial hydrological and isotope hydrological studies in bore holes, receiving water courses, and the Asse salt deposit. The third chapter summarises the latest developments in terms of methods and instruments for isotope hydrology (He-3, He-4, C-14, Kr-85). (DG).

43512 (INIS-mf–11503, pp. 80) **Parametric studies of groundwater contamination models.** Reznik, L. (Israel Electric Corp. Ltd., Haifa (Israel). Dept. of Nuclear Engineering); Sharf, H.; Tepper, L. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Summary only.

43513 (INIS-mf–11989, pp. 223) **Study of the variation of the sedimentation rate in Guanabara Bay, Brazil, using Pb-210.** Moreira, I. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica); Mendes, L.; Godoy, J.M. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

43514 (INIS-mf–11989, pp. 223) **Radon-222: A flow tracer for groundwater infiltration.** Gunten, H.R. von (Paul Scherrer Inst., Villigen (Switzerland)); Hoehn, E. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). 1989. (CONF-890617–: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). In *Second Karlsruhe international conference on analytical chemistry in nuclear technology. Abstracts.* Order Number DE89796170/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Published in summary form only.

43515 (PB–89-169890/XAB) **Uranium removal from drinking water using a small full-scale system.** Jelinek, R.T.; Clemmer, R.L.; Johns, F.J. Arber (Richard P.) Associates, Inc., Denver, CO (USA). Mar 1989. 47p. Available from NTIS, PC A03/MF A01.

This report presents background and history of water quality, the basis for design and nine months of actual operating data for a small, full-scale strong-base ion-exchange system that is used to remove uranium from a water supply serving a school in Jefferson County, CO. Information is also presented on the effectiveness of regeneration, the gamma-radiation profile of the system, and the capital and O/M costs of the system. Because of no on-site disposal system, the regeneration waste water is hauled away to a school district waste water treatment plant at a cost of $2.40 per 1,000 gallons of treated water.

43516 (PB–89-862643/XAB) **Radioactive pollution: ocean environments. January 1974-May 1989 (Citations from Oceanic Abstracts). Report for January 1974-May 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 60p. Available from NTISPC N01/MF N01.

This bibliography contains citations concerning radioactive pollution of the marine environment. Distributions of radionuclides indicative of artificial radioactive contamination are discussed including iodine-131, various uranium isotopes, cesium-137, cobalt-60, strontium-90, ruthenium-160, and plutonium isotopes. Ecosystems considered include coral reefs and atolls, planktonic zones in the open ocean, salt marshes, estuaries, coastal waters, and the Mediterranean Sea. Sources of radioactive contamination examined include atomic bomb blasts, fossil-fuel combustion, radioactive waste disposal, and nuclear accidents. Experimental simulation of radionuclide transport in marine biota is included. (Contains 108 citations fully indexed and including a title list.)

5204 Thermal Effluents Monitoring and Transport

Refer also to citation(s) 41829

5205 Site Resource and Use Studies

Refer also to citation(s) 41768, 42220, 42238, 43575

43517 (PB–89-178552/XAB) **Illinois self-help consortium for water and waste-water projects. Final report.** Levesque, C.W. Illinois Community Action Association, Springfield, IL (USA). Mar 1989. 55p. Available from NTIS, PC A04/MF A01.

This report documents the development and proposed implementation of an initial self-help project for water and waste water in Illinois. It describes the creation of a Self-Help Consortium composed of leading state agencies to test the application of self-help principles in developing water and wastewater systems in Illinois. The report includes a review of existing environmental programs with self-help components in other states, outlines self-help and its institutionalization within the New York State Self-Help Support System, proposes a similar structure for the delivery of self-help assistance in Illinois and identifies a set of Illinois, communities in which self-help might be tested. The report is recommended for individuals interested in both the concept of 'self-help' as well as the process by which program proposals are translated into extant initiatives.

43518 (PB–89-864730/XAB) **Water resources: effects of land use and urbanization. September 1981-June 1989 (Citations from the NTIS data base). Report for September 1981-June 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 98p. Available from NTISPC N01/MF N01.

Supersedes PB–88-864913.

This bibliography contains citations concerning the effects of land use and urban development on water-supply quality and quantity. Topics include appropriate local, state, and federal government policies, and utilization of mathematical models as predictive tools. Studies performed at specific localities are included if they provide comprehensive strategies that can be applied to other locations. (This updated bibliography contains 177 citations, 54 of which are new entries to the previous edition.)

5206 Regulations

Refer also to citation(s) 42222, 42367, 43457, 43460, 43461, 43462, 43463, 43465, 43466

43519 (CPS–4HA1) **Summary of environmental criteria for polychlorinated biphenyls (PCBs).** Environnement Canada, Ottawa, ON (Canada). Conservation et Protection. 1987. 50p. (In English and French). (MICROLOG–87-04943). Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The tables in this report summarize the criteria for polychlorinated biphenyls (PCBs) in various environmental media. Information concerning such topics as regulations and guidelines for PCBs in the environment (air, water, soil, food, waste) has been gathered from the available literature, legislation, international agencies, federal government departments, provincial offices, and Environment Canada Regional Offices. Information was sought on existing guidelines and regulations, and on guidelines and criteria which were being considered, developed, or used as internal rules of thumb for management decision-making. Many of the provinces did not have their own specific guidelines, but had implemented, or were moving to implement federal guidelines and regulations. The information obtained is summarized in a table which also includes limited information from other countries for comparison. Rationales used in Canada and the USA to develop or arrive at some of the more important environmental guidelines, criteria, and tolerances, are also described. These rationales are discussed for guidelines relating to PCB concentrations in ambient air and water, drinking water, dredge spoil, food and occupational air. 51 refs 2 tabs

43520 (PB–89-167969/XAB) **Guidance document for providing alternate water supplies.** CDM Federal Programs Corp., Annandale, VA (USA). Feb 1988. 65p. Available from NTIS, PC A04/MF A01.

See also PB–85-238616.

This document serves as EPA guidance for providing information when it becomes necessary to develop or obtain alternate water supplies where releases of hazardous substances or pollutants have resulted in the closing of drinking water wells or has contaminated a principal drinking water supply. The information was prepared to assist Superfund contractors and on-scene Federal, State, and local officials with the planning and implementation of alternate water supplies at uncontrolled hazardous-waste sites. Guidance is specifically provided for those sites that do not require a time-critical removal action, but do require provision of an alternate water supply as either a non-time-critical removal actions of 6 months or more or a remedial action before implementation of a final remedy can be achieved (actions performed at National Priority List sites where short-term threats to the human population exist). These remedial actions are used to provide faster response than can be achieved with normal remedial actions. The decision-making process used in the document discusses the determination of water supply needs, screening and evaluating alternatives, and implementing the remedy.

43521 (PB–89-169197/XAB) **National Marine Pollution Program: federal plan for ocean pollution research, development, and monitoring, fiscal years 1988-1992.** National Ocean Pollution Program Office, Rockville, MD (USA). Sep 1988. 247p. Available from NTIS, PC A11/MF A01.

Also available from Supt. of Docs. See also PB–86-158813.

The National Marine Pollution Program is the composite of all programs funded by the Federal Government that conduct marine pollution research, development, or monitoring activities. In FY 1988, the Federal Government expended an estimated $107.2 million for marine pollution research and monitoring activities. These activities were funded by 11 Federal departments and independent agencies and included studies pertaining to pollution in coastal areas, estuaries, open oceans, and the Great Lakes. The Plan represents the fourth such document in the continuing interagency planning process called for in the National Ocean Pollution Planning Act of 1978 (P.L. 95-273), as amended. As required by the Act, a comprehensive 5-year Plan for the overall Federal effort is prepared and updated every 3 years. The Plan identifies national marine pollution needs and problems, describes the existing Federal capability for conducting marine pollution research and monitoring.

43522 (PB–89-169825/XAB) **Ambient water-quality criteria for 2,3,7,8-tetrachlorodibenzo-p-dioxin.** Stephen, C.E. Environmental Protection Agency, Washington, DC (USA). Office of Water Regulations and Standards. Feb 1984. 291p. (EPA–440/5-84/007). Available from NTIS, PC A13/MF A01.

Pursuant to Section 304(A)(1) of the Clean Water Act, this document was developed to publish criteria for water quality accurately reflecting the latest scientific knowledge. A summary of the criteria for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) is as follows. Not

enough data are available concerning the effects of 2,3,7,8-TCDD on aquatic life and its uses to allow derivation of national criteria. For the maximum protection of human health from the potential carcinogenic effects due to exposure to 2,3,7,8-TCDD through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Other concentrations representing different risk levels may be calculated. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an 'acceptable' risk level.

43523 (PB–89-173751/XAB) **Developing a state wellhead protection program: a user's guide to assist state agencies under the Safe Drinking Water Act.** Roy, S. ICF, Inc., Fairfax, VA (USA). Jul 1988. 48p. Available from NTIS, PC A03/MF A01.

The 1986 Amendments to the Safe Drinking Water Act established a new Wellhead Protection (WHP) Program to protect ground water that supplies drinking water wells from sources of contamination. Under Section 1428 of the Act, each State must prepare a WHP program and submit it to EPA by June 19, 1989. Although the law requires that every State WHP program must contain specific elements, EPA recognizes that States should be allowed flexibility to tailor program details to best suit their individual needs. The document provides an overview of the major program requirements, presents major messages that a State should consider while developing a WHP program, and presents case-study examples to illustrate how a State might address each element of its WHP program.

43524 (PB–89-175475/XAB) **Survey of state ground-water-quality protection legislation enacted from 1985 through 1987.** National Conference of State Legislatures, Denver, CO (USA). Oct 1988. 108p. Available from NTIS, PC A06/MF A01.

See also PB–88-111968.

Eight major categories of legislation are summarized in the report: statewide strategies, ground-water classification, standard setting, land-use management, ground-water funds, agricultural chemicals, underground storage tanks, and water-use management. The report is divided into three sections: Part One compares legislation enacted in each state during the 1985-1987 sessions by category of legislation, in matrix form; Part Two summarizes all categories of legislation enacted on a state-by-state basis; and Part Three presents the legislation on a category-by-category basis. The survey of 1985 state legislation published by OGWP in 1987 was incorporated into the report.

43525 (PB–89-179865/XAB) **Comprehensive research plan: an agreement commitment report from the Chesapeake Executive Council. Final report.** Environmental Protection Agency, Annapolis, MD (USA). Chesapeake Bay Program. Jul 1988. 64p. Available from NTIS, PC A04/MF A01.

The plan outlines a process for meeting long-term research needs of the Chesapeake Bay Program. Recommendations include establishing the Research Planning Committee as a standing committee, development of a Chesapeake Bay research directory to be updated annually, an annual assessment of the previous year's research achievements, and an annual listing of research priorities including estimates of funding and resource requirements.

43526 (PB–89-179899/XAB) **Federal work plan: an agreement commitment report from the Chesapeake Executive Council. Final report.** Environmental Protection Agency, Annapolis, MD (USA). Chesapeake Bay Program. Jul 1988. 109p. Available from NTIS, PC A06/MF A01.

The work plan describes each participating Federal agency's Bay initiatives and the current level of coordination, outlines a process for expanding that cooperation, and indicates future directions for agency efforts in support of the 1987 Bay Agreement. The plan includes projections of possible projects and programs which may be the basis for coordinated, complementary budget proposals in the future.

43527 (PB–89-179907/XAB) **Federal facilities strategy: an agreement commitment report from the Chesapeake Executive Council. Final report.** Environmental Protection Agency, Annapolis, MD (USA). Chesapeake Bay Program. Jul 1988. 50p. Available from NTIS, PC A03/MF A01.

The Strategy identifies Federal facilities with the potential to affect the water quality and living resources of the Chesapeake Bay and establishes a timetable for implementation.

43528 (PB–89-179915/XAB) **Schedule for developing Baywide Resource Management Strategies: an agreement commitment report from the Chesapeake Executive Council. Final report.** Environmental Protection Agency, Annapolis, MD (USA). Chesapeake Bay Program. Jul 1988. 31p. Available from NTIS, PC A03/MF A01.

Schedules development of resource-management strategies to ensure that appropriate short- and long-term efforts for restoration and protection are under way Baywide. Includes target dates for developing resource-management strategies for submerged aquatic vegetation, tidal and non-tidal wetlands, waterfowl, finfish, shellfish, and other ecologically-valuable species.

43529 (PB–89-179923/XAB) **Baywide conventional pollutants control strategy: an agreement commitment report from the Chesapeake Executive Council. Final report.** Environmental Protection Agency, Annapolis, MD (USA). Chesapeake Bay Program. Jul 1988. 50p. Available from NTIS, PC A03/MF A01.

See also PB–88-142823.

The strategy outlines programs under way and planned by Bay watershed jurisdictions (Pennsylvania, Virginia, the District of Columbia, Maryland) to address the water-quality problems caused by conventional pollutants. It calls for a coordinated effort to improve the quality of control programs and proposes an annual Conventional Pollutant Working Conference to provide an information exchange forum.

43530 (PB–89-179956/XAB) **Chesapeake Bay wetlands policy: an agreement commitment report from the Chesapeake Executive Council. Final report.** Environmental Protection Agency, Annapolis, MD (USA). Chesapeake Bay Program. Dec 1988. 19p. Available from NTIS, PC A03/MF A01.

The Policy addresses the protection and restoration of both tidal and non-tidal wetlands through several elements, each with attendant policy goals and specific action items. The elements comprise a comprehensive wetland protection strategy with the immediate goal of no net-loss and the long-term goal of a net resource gain.

43531 (PB–89-179964/XAB) **Technical assistance and incentives to local governments. An agreement commitment report from the Chesapeake Executive Council. Final report.** Environmental Protection Agency, Annapolis, MD (USA). Chesapeake Bay Program. Dec 1988. 44p. Available from NTIS, PC A03/MF A01.

This report discusses fragile natural areas and ways in which governments can help protect them, presents in matrix form a listing of technical assistance and incentive programs currently available to local governments, and outlines a strategy for developing a more complete and more fully integrated set of technical assistance and incentive programs.

43532 (PB–89-182513/XAB) **Superfund Record of Decision (EPA Region 2): Brewster Well Field, Village of Brewster, Putnam County, New York (second remedial action), September 1988. Final report.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. 29 Sep 1988. 44p. (EPA/ROD/R–02-88/066). Available from NTIS, PC A03/MF A01.

See also PB–87-188850.

The Brewster Well Field consists of two municipal well fields, No. 1 and No. 2, located on the northern bank of the East Branch Croton River, 3/4 of a mile east of the Village of Brewster, Town of Southeast in Putnam, New York. The 18 shallow wells in the field are a source of water for the municipal water system that serves over 2,100 residents in the Village of Brewster and the Town of Southeast, as well as a number of businesses and a railyard. Additional receptors of the ground water from this aquifer include downstream users of the East Branch Croton River, which contributes to the Croton Falls Reservoir approximately 3.5 miles downstream. Also, two reservoirs exist upstream to the east and northeast within 3000 feet of the site, which are part of New York City's Croton watershed

reservoir system. Land use to the north and west is predominantly residential, and to the south commercial and light industrial.

43533 (PB–89-184071/XAB) **Superfund Record of Decision (EPA Region 5): Environmental Conservation and Chemical Corporation, and Northside Sanitary Landfill, Zionsville, Indiana (first remedial action), September 1987. Final report.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. 29 Sep 1987. 107p. (EPA/ROD/R–05-87/049). Available from NTIS, PC A06/MF A01.

Portions of this document are not fully legible.

The Northside Sanitary Landfill (NSL) and the Environmental Conservation and Chemical Corporation (ECC) are adjacent sites located in Boone County, Indiana. These two sites were combined into the first remedial action because of their close proximity and similarities in contaminants. Between 1977 and 1981 some still bottom and oily liquid wastes were permitted to be disposed of at NSL. Sometime between 1955 and 1962, NSL began landfill operations. From 1972 to 1973, numerous operational deficiencies, including failure to cover refuse, surface burning, underground fires, leachate and vermin problems resulted in three Indiana State Board of Health (ISBH) orders to cease operations. Ground water, surface water, soil and sediments are contaminated with inorganics, organics, pesticides, acids, base-neutral compounds, oils and VOCs including benzene, 1,1-DCE and TCE. The recommended alternative for the two sites combined includes: implementing deed and access restrictions to prevent future site development; excavation and dewatering of 4,200 cu yds. of leachate soils and sediments with onsite disposal under an RCRA multi-layer cap.

43534 (PB–89-184618/XAB) **Guidance on remedial actions for contaminated ground water at Superfund sites. Interim report (Final).** CH2M Hill, Gainesville, FL (USA). Dec 1988. 123p. Available from NTIS, PC A06/MF A01.

Also available from Supt. of Docs.

The guidance document focuses on key issues in the development, evaluation, and selection of ground-water remedial actions at Superfund sites. Statutory mandates require that remedies be protective and utilize permanent solutions and treatment technologies to the maximum extent practicable. Consistent with these mandates, the goal of Superfund ground-water actions is to restore groundwater to its beneficial uses within a reasonable time frame, given the particular site circumstances. The document presents the analytical framework and statutory basis for formulating ground-water alternatives, outlines factors that should be examined to evaluate and compare ground-water alternatives, highlights key considerations for selecting a ground-water remedy, and illustrates with a case study the remedial investigation and feasibility study process for ground-water. Although each Superfund site presents unique environmental conditions and human health problems, a consistent approach should be used when collecting and analyzing data and developing and evaluating ground water remedial alternatives.

43535 (PB–89-187421/XAB) **Report to Congress: Indian waste-water treatment needs and assistance.** Environmental Protection Agency, Washington, DC (USA). Office of Municipal Pollution Control. Jan 1989. 48p. (EPA–430/9-88/006). Available from NTIS, PC A03/MF A01.

This report was prepared in cooperation with the Indian Health Service (IHS) to meet the requirements of Section 518(b) of the Clean Water Act (CWA) as amended by the Water Quality Act (WQA) of 1987. The report's five major objectives are as follows: to summarize EPA's assessment of Indian waste-water treatment construction needs, to report on the degree to which such needs will be met through CWA funding, to identify any obstacles that may prevent such needs from being met, to discuss how EPA plans to implement the Indian Set-Aside Program established under Section 518(c) of the CWA, and to describe EPA's efforts to maximize Indian participation in CWA programs.

43536 (PB–89-188726/XAB) **Superfund Record of Decision (EPA Region 7): Midwest Manufacturing/North Farm Superfund Site. North Farm operable unit, Kellogg, Iowa, (first remedial action), September 1988.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. 30 Sep 1988. 62p. (EPA/ROD/R–07-88/019). Available from NTIS, PC A04/MF A01.

This document describes the remedy that the U.S. Environmental Protection Agency (EPA) has selected to implement at the North Farm subsite of the Midwest Manufacturing/North Farm Site located near Kellogg, Iowa. The document also describes the decision-making procedures that were followed in selecting the preferred remedial action. The remedial action was selected to remedy an environmental problem that could potentially affect the health of the residents who may choose to live at the site in the future. Records indicate that electroplating activities took place at the site and involved the use of various heavy metals. A waste-water treatment plant was installed at the facility to treat the plant effluent before it was discharged into the local river. Solids generated at the treatment plant were temporarily stored in a tank onsite and periodically transferred to the disposal cell. Soil sampling was conducted onsite and downslope to evaluate the potential for contaminant migration due to previous waste-disposal practices. Analysis of the samples revealed that soil contamination had occurred via surface run-off.

43537 (PB–89-188783/XAB) **Superfund Record of Decision (EPA Region 2): Mid-State Disposal Landfill, Marathon Battery, Cold Spring, New York, (second remedial action), September 1988.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. 30 Sep 1988. 343p. (EPA/ROD/R–02-88/064). Available from NTIS, PC A15/MF A01.

See also PB–87-190096. Portions of this document are not fully legible.

The Marathon Battery Company (MBC) site, a former battery manufacturing plant, is located in the Village of Cold Spring in Putnam, New York, approximately 40 miles north of New York City. The site operated from 1952 to 1979 producing military and commercial batteries. During this time the site changed ownership several times, finally operating as the MBC from 1969 to 1979. Before 1965, the plant's wastewater treatment system discharged into the Hudson River at the Cold Spring pier via the Cold Spring sewer system, except during periods of overload or system shutdown during which time the process effluent was discharged directly into East Foundry Cove Marsh (EFCM) to the southeast. Between November 1972 and July 1973, a limited cleanup was conducted by MBC and other responsible parties, to remove sediment from parts of Foundry Cove and surrounding areas contaminated with cadmium and nickel in excess of 900 mg/kg. The selected remedial action for Area II at this site includes: decontamination of the former battery facility; excavation; and offsite disposal.

43538 (PB–89-189468/XAB) **Superfund Record of Decision (EPA Region 3): West Virginia Ordnance Works, Mason County, West Virginia, (second remedial action), September 1988. Final report.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. Sep 1988. 62p. (EPA/ROD/R–03-88/053). Available from NTIS, PC A04/MF A01.

See also PB–88-106455. Portions of this document are not fully legible.

The West Virginia Ordnance (WVO) site covers approximately 8,323 acres in Mason County, West Virginia. It is located on the east bank of the Ohio River. General Chemical Defense Corporation of New York operated the plant until 1945. Red and yellow water (liquid wastes) were produced during the TNT manufacturing process. Yellow water was discharged to the Mill Creek drainage system, which eventually drains into the Ohio River; red water was discharged directly to the Ohio River through a pipe located about one foot offshore. In May 1981, ranger officials observed a seep of red water adjacent to a pond located on the wildlife station. Upon examination, ground water discharging to this pond was found to be contaminated by di- and trinitrotoluenes and phenol. The selected remedial action for this site addresses three distinct areas of contamination.

43539 (PB–89-189484/XAB) **Superfund Record of Decision (EPA Region 2): Beachwood/Berkeley Wells, Ocean County, New Jersey (first remedial action), June 1988. Final report.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. Jun 1988. 45p. (EPA/ROD/R–02-88/062). Available from NTIS, PC A03/MF A01.

The Beachwood/Berkeley Well site, encompasses Beachwood Borough and Berkeley Township in central-east Ocean City, NJ. The total population of the two municipalities is approximately 23,000. In response to a public complaint of possible aluminum contamination of drinking water, the New Jersey Department of Environmental Protection (NJDEP) sampled four potable wells and discovered the presence of lead in exceedance of the Federal Interim Primary Drinking Water Standard. Subsequent sampling confirmed the presence of lead at approximately 4 times the standard. It was concluded that elevated concentrations of lead in drinking water were not caused by man-made or industrial sources. Rather, the sources of lead include: a minor contribution from native-area ground water, lead packers used in well construction, and dissolution of lead from lead-bearing materials of home plumbing systems, particularly lead/tin solder. The State of New Jersey is proceeding independently of Federal Superfund financing to address the presence of and the problems posed by lead in drinking water.

43540 (PB–89-189518/XAB) **Superfund Record of Decision (EPA Region 2): GE Wiring Devices, Juana Diaz, Puerto Rico (first remedial action), September 1988. Final report.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. Sep 1988. 36p. (EPA/ROD/R–02-88/069). Available from NTIS, PC A03/MF A01.

The GE Wiring Devices site is located in Juana Diaz, Puerto Rico. The General Electric Company (G.E.) owns and operates a five-acre wiring devices plant at this site, which assembled silent mercury switches from 1957 until 1969. Approximately half a ton of mercury was discarded along with 4,000 cu yds of defective switch parts and plastic scraps in an onsite waste-fill area about 1 acre in area and 1 to 4 feet deep. Ground water in the area is used as a source of drinking water with a public supply well located approximately 1,500 feet west of the waste-fill area. Evidence indicates that contamination of the water table is occurring due to the migration of perch water through the clay layer that exists beneath the waste-fill area. Approximately 1,500 cu yds of near-surface soil south and downgradient of the waste-fill area has been contaminated by mercury as a result of previous surface runoff from the plant area. The selected remedial action for this site includes: onsite hydrometallurgical treatment of the waste-fill materials, perched water, and contaminated near-surface soil with disposal of the treatment residue in the former waste-fill area, followed by covering with a clean soil cover, and onsite treatment of the process leaching agent.

43541 (PB–89-190581/XAB) **USEPA (Environmental Protection Agency) method study 36 SW-846 methods 8270/3510, GC/MS (gas chromatography/mass spectrometry) method for semivolatile organics: capillary-column technique separatory-funnel liquid-liquid extraction. Final report, September 1986-December 1987.** Edgell, K.W.; Wesselman, R.J. Bionetics Corp., Cincinnati, OH (USA). Apr 1989. 289p. (EPA–600/4-89/010). Available from NTIS, PC A13/MF A01.

An interlaboratory collaborative study was conducted to determine the precision and bias (recovery) of Office of Solid Waste (OSW) 8270/3510 for the analysis of 59 semivolatile organic compounds in groundwater. OSW Method 8270 is entitled 'GC/MS Method for Semivolatile Organics Capillary Column Technique' and includes instructions for quality control, sample preparation, and analysis of samples by GC/MS. OSW Method 3510 is entitled 'Separatory Funnel Liqui-Liquid Extraction.' The study design was based upon Youden's non-replicate plan for collaborative tests of analytical methods. Each water type was spiked with three Youden sample pairs of the 59 semivolatile compounds and analyzed using Methods 8270/3510. The test waters included reagent water as a 'control' against which other test data were compared and two types of ground water. The resulting data were analyzed using the USEPA computer program entitled, 'Interlaboratory Method Validation Study (IMVS).' The data analyses produced measures of precision and recovery for each compound in each water type and compared the performance of the method between water types.

53 ENVIRONMENTAL–SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social and Economic Studies

Refer also to citation(s) 42229

43542 (GU–87-02) **Implications of climatic change for agriculture in Ontario. A summary of Land Evaluation Group reports.** Smit, B. Guelph Univ., ON (Canada). 1987. 50p. (In English and French). (MICROLOG–87-04819). Available from Canadian Program Office, Canadian Climate Centre, 4905 Dufferin Street, Downsview, ON, CAN M3H 5T4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report summarizes the results of two studies of the impacts of climate change on the agri-food sector in Ontario. Two scenarios for climatic change associated with an increase in atmospheric concentrations of carbon dioxide were used, based on models developed by two different research organizations. The potential impacts of each scenario were assessed on the following aspects: climatic resources for crop production; productivity levels for major crops; current levels and value of crop production; and economic suitability of land resources for crop production. The study was designed to gauge the sensitivity of each aspect of agriculture to the specified changes in climatic conditions, as measured by comparing possible adjustments to each aspect given changes in climate from current norms. It was demonstrated that climatic changes could have profound effects on Ontario's agri-food sector. New opportunities for agricultural production in northern Ontario suggest prospects for a major expansion of the agricultural economy there. In other regions, especially the agricultural heartland of the southwest, production prospects for many common crops would be diminished. There also appear to be opportunities for diversifying agriculture in other regions of the province. The length of the growing season is likely to become less of a constraint, but moisture deficit is expected to become a more important limiting factor. 5 figs., 4 tabs.

5302 Assessment of Energy Technologies

43543 (ACUNS–8701, pp. 154-163) **The natural realm in the Arctic. A critique from a developmental perspective.** French, H.M. Association of Canadian Universities for Northern Studies (ACUNS), Ottawa, ON (Canada). 1987. (CONF-8508276–: Arctic heritage, Banff (Canada), 24-28 Aug 1985; MICROLOG–87-03004). In *Arctic heritage. Proceedings of a symposium.* Available from Association of Canadian Universities for Northern Studies, 130 Albert Street, Ottawa, ON, CAN K1P 5G4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The intent of this paper is to assess the significance of our current understanding of the physical environment of Canda's Arctic within a context of assumed economic development in the area. As second objective is to illustrate the degree to which certain geotechnical problems associated with northern development have been solved. At least two perspecitves are highlighted. These are: the belief that in the longrun, it is probably more difficult to restrict industrial activities in the Arctic than those of tourism and the local inhabitants, and the often conflicting opinions concerning the sensitivity of the physical environment of the Arctic, and its variable ability to withstand stress. There is no doubt that natural resources development, especially that of hydrocarbons will be the major stress imposed upon northern Canada in the next thirty years. One problem which complicates the adoption of any one preservation strategy is that the sensitivity of the arctic environment to an imposed stress, or streses, is difficult to determine. Some research into consequences of terrain disturbance, geotechnical responses, and frost heave problems are outlined. There is no doupt that man is able to disrupt seriously the unique Arctic environments, probably with more long lasting, costly, and devastating results than in any other environment. On the other hand, there is evidence that man is capable and willing to minimize the deleterious long-term effects associated with economic development. Furthermore, the physical environment is probaly better able

to adjust to these impacts than is commonly assumed. Finally, improvements in industrial operating techniques in northern regions will also act ot mitigate environmental impact. 20 refs., 4 figs.

43544 (AD-A–206086/1/XAB) **Environmental Impact Statement. Peacekeeper Rail Garrison Program. Executive Summary. Final report.** Air Force Regional Civil Engineer, Norton AFB, CA (USA). Ballistic Missile Support. Feb 1989. 60p. Available from NTIS, PC A04/MF A01.

The U.S. Air Force proposes to deploy 50 Peacekeeper missiles on 25 trains, which will be based at F.E. Warren AFB, Wyoming, and at up to 10 other Air Force installations. If the Peacekeeper Rail Garrison system is approved for deployment, F.E. Warren AFB would be the Main Operating Base (MOB) and the first garrison installation. After the EIS is filed, the other garrison installations to be used would be selected from the 10 candidates and the decision would be documented in one or more Records of Decision. Up to four trains could be deployed at the MOB and at each selected garrison installation. Peacekeeper missiles would be assembled and integrated onto missile launch cars at F.E. Warren AFB and then dispatched to other selected garrison installations. Periodically, a training train, with no missile propellants or warheads onboard, would travel to each of the garrison installations for operations, security, and maintenance training. Periodically, for maintenance or test launches, missiles (without warheads) would be moved by rail between garrisons and F.E. Warren AFB, Wyoming or Vandenberg AFB, California. During periods of national need and upon receipt of direction from a higher authority, Peacekeeper trains could be dispersed onto the national rail network to improve their survivability. Potential environmental impacts are considered in the FEIS under the following environmental resource categories: socioeconomics, utilities, transportation, land use, cultural, biological, water, geology and soils, air quality, and noise. In addition, national economic impacts, national railroad transportation impacts, and safety considerations are discussed.

43545 (AD-A–206087/9/XAB) **Environmental Impact Statement. Peacekeeper Rail Garrison Program. Volume 1. Final report.** Air Force Regional Civil Engineer, Norton AFB, CA (USA). Ballistic Missile Support. Feb 1989. 853p. Available from NTIS, PC A99/MF E04.

See also Volume 2, AD-A206 088.

The U.S. Air Force proposes to deploy 50 Peacekeeper missiles on 25 trains, which will be based at F.E. AFB, Wyoming, and at up to 10 other Air Force installations. If the Peacekeeper Rail Garrison system is approved for deployment, F.E. Warren AFB would be the Main Operating Base (MOB) and the first garrison installation. After the EIS is filed, the other garrison installations to be used would be selected from the 10 candidates and the decision would be documented in one or more Records of Decision. Up to four trains could be deployed at the MOB and at each selected garrison installation. Peacekeeper missiles would be assembled and integrated onto missile launch cars at F.E. Warren AFB and then dispatched to other selected garrison installations. Periodically, a train, with no missile propellants or warheads onboard, would travel to each of the garrison installations for operations, security, and maintenance training. Periodically, for maintenance or test launches, missiles (without warheads) would be moved by rail between garrisons and F.E. Warren AFB, Wyoming or Vandenberg AFB, California. During the periods of national need and upon receipt of direction from the National Command Authority, Peacekeeper trains could be dispersed onto the national rail network to improve their survivability. Potential environmental impacts are considered in the FEIS under the following environmental resource categories: socioeconomics, utilities, transportation, land use, cultural, biological, water, geology and soils, air quality, and noise. In addition, national economic impacts, national railroad transportation impacts, and safety considerations are discussed.

43546 (AD-A–206088/7/XAB) **Environmental Impact Statement. Peacekeeper Rail Garrison Program. Volume 2. Public comments. Final report.** Air Force Regional Civil Engineer, Norton AFB, CA (USA). Ballistic Missile Support. Feb 1989. 845p. Available from NTIS, PC A99/MF E04.

See also Volume 1, AD-A206 087.

This Volume of the Final Environment Impact Statement (EIS) includes comments and responses on the Draft EIS for the Peacekeeper Rail Garrison program at F.E. Warren Air Force Base (AFB), Wyoming and ten candidate deployment installations; all original written comment documents; and public hearing transcripts (comments sections only) as recorded by court reporters for each of the 11 public hearings held on the Draft EIS.

43547 (AD-A–206960/7/XAB) **Draft environmental impact statement: Peacekeeper rail garrison program.** Department of the Air Force, Washington, DC (USA). Jun 1988. 777p. Available from NTIS, PC A99/MF E04.

The U.S. Air Force proposes to deploy 50 Peacekeeper missiles on 25 trains, which will be based at F.E. Warren AFB, Wyoming, and at up to ten other garrison installations. Peacekeeper missiles would be assembled and integrated onto the missile launch cars at F.E. Warren AFB and then dispatched to other selected garrison installations. Periodically, a training train, with no missile propellants or warheads onboard, would travel to each of the garrison installations for operations, security, and maintenance training. Periodically, for maintenance or test launches, missiles (without warheads) would be moved by rail between garrisons and P.E. Warren AFB or Vandenberg AFB. During periods of national need and upon receipt of direction from the National Command Authority, Peacekeeper trains could be dispersed onto the nation's rail network to improve their survivability. The Alternative Action is to deploy 100 Peacekeeper missiles on 50 trains. Potential environmental impacts associated with both of these actions are considered in the DEIS under the following environmental resource categories: socioeconomics, utilities, transportation, land use, cultural, biological, water, geology and soils, air quality, and noise. In addition, national economic impacts, national railroad transportation impacts, and safety considerations are discussed. Finally, mitigation measures that can be taken to rehabilitate or restore the affected environment or to reduce significant adverse impacts are identified.

43548 (DOE/AL/10752–41) **Review of the draft supplement environmental impact statement: DOE/EIS-0026-DS, Volumes 1 and 2, DOE Waste Isolation Pilot Plant, April 1989.** Environmental Evaluation Group, Albuquerque, NM (USA). Jul 1989. 110p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-78AL10752. (EGG–41). Order Number DE89015377/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The Draft Supplement Environmental Impact Statement (SEIS) for WIPP does not provide adequate justification to support the proposed action of shipping up to 620,000 cubic feet of transuranic (TRU) waste to WIPP before demonstrating compliance with the Environmental Protection Agency's (EPA) Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes. The "alternative action" of shipping no waste to WIPP prior to demonstrating compliance with the EPA Standards has been dismissed without sufficient discussion and justification. The document contains mistakes in calculations, reflects an erroneous knowledge of the history of the project, presents tables without units, and displays an indifference to the statistical precision of predictions. It also does not adequately address the environmental impacts of the potential failure to complete the demonstration of compliance with the EPA Standards by October 1993. By comparison, DOE plans to complete the demonstration of compliance with the same standards before starting construction of the high-level waste repository in Nevada. These two diametrically opposed approaches by DOE, for WIPP and for the Yucca Mountain repository, need to be addressed.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

43549 (PB–89-179998/XAB) **Caring for our natural community: Region 1. Threatened, endangered, and sensitive species program.** Reel, S.; Schassberger, L.; Ruediger, W. Forest Service, Missoula, MT (USA). Region I. 1989. 346p. Available from NTIS, PC A15/MF A01.

Also available from Supt. of Docs.

This report is a summary of Region One's threatened, endangered, and sensitive plant, fish, and wildlife resources, as well as a summary of the program to conserve each species. The program information was developed at the field level and reflects what could be accomplished under existing Forest Plans.

5501 Behavioral Biology

43550 (PB–89-178131/XAB) **Ecology and conservation of the endangered least Bell's vireo. Biological report.** Franzreb, K.E. Fish and Wildlife Service, Sacarmento, CA (USA). Mar 1989. 25p. (BIOLOGICAL–89(1)). Available from NTIS, PC A03/MF A01.

At one time considered common, the least Bell's vireo (Vireo bellii pusillus) was distributed throughout the Central Valley and other low elevation riverine systems in California and Baja California, Mexico, but now has been extirpated from the majority of its breeding range. Habitat loss from agricultural, urban, and commercial activities, as well as other habitat modifying actions has severely restricted the bird's range. Predation by brown-headed cowbirds is now the major problem in the the few remaining habitats of this endangered bird. Extensive suitable riparian habitat for the least Bell's vireo must be secured and protected so that the population may increase and be maintained in perpetuity. Methods to reintroduce vireos into the Central Valley and other areas within the historical range that are presently unoccupied should be evaluated.

5502 Biochemistry

Refer also to citation(s) 41801, 41840

43551 (DOE/ER/13426–3) **Structural studies of complex carbohydrates of plant cell walls: Progress report, December 1986–June 1989.** Darvill, A. Georgia Univ., Athens, GA (USA). Complex Carbohydrate Research Center. Jun 1989. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract FG09-85ER13426. Order Number DE89015797/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Characterizing the polysaccharides that constitute the primary cell walls of plants has been a major research goal of our laboratory for many years. During the past three years we have made considerable progress towards this goal. In particular, we have emphasized the structural studies of three of the major non-cellulosic polysaccharides; namely, the pectic polysaccharides rhamnogalacturonan I (RG-I), and rhamnogalacturonan II (RG-II), and the hemicellulosic polysaccharide xyloglucan. We have identified and partially characterized the major pectic polysaccharides present in the primary cell walls of suspension-cultured monocot (maize and rice) and gymnosperm (Douglas fir) cells. We have come to realize that RG-I, RG-II and xyloglucan, together with homogalacturonan are arabinoxylan, constitute the predominant non-cellulosic polysaccharides of primary cell walls. In fact, we have accumulated considerable evidence to suggest that these are the predominant and perhaps only non-cellulosic polysaccharides of primary cell walls. While writing a comprehensive review of the pectic polysaccharides of primary cell walls we came to realize that all of the pectic polysaccharide fragments described in the literature may have originated from homogalacturonan, RG-I, or RG-II. Indeed, we have been quite surprised by the remarkable structural conservation of these very complicated polysaccharides in cell walls originating from such evolutionarily diverse plants. Furthermore, our structural studies of cell wall hemicellulosic xyloglucan have reinforced the concept that cell wall polysaccharides have extremely complicated and evolutionarily-conserved structures.

43552 (DOE/ER/13709–3) **Molecular characterization of phytochrome from green avena: Technical progress report.** Georgia Univ., Athens, GA (USA). Research Foundation. Jul 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract FG09-87ER13709. Order Number DE89015800/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Both the physicochemical properties of phytochrome and its biological functions are best understood with reference to etiolated plant tissues. Phytochrome plays, however, and important role in green plants as well. For many years it was tacitly assumed that phytochrome in green plants was the same as that in etiolated seedings, primarily because it is exceedingly difficult to isolate and characterize phytochrome from green plants. Nevertheless, it was occasionally hypothesized that phytochrome should be heterogeneous, with different types of phytochrome predominating in dark- and light-grown tissue. Largely as the result of DOE-funded research programs over the past eight years, these early hypotheses have been found to be valid. It is now evident that etiolated- and green-plant phytochromes are distinctly different from one another. 5 figs.

43553 (LA-UR–89-2451) **A nonlinear model for DNA dynamics.** Muto, V.; Scott, A.C.; Christiansen, P.L. Los Alamos National Lab., NM (USA). Jul 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8908104–2: 7. international conference on mathematical and computer modelling, Chicago, IL (USA), 2-5 Aug 1989). Order Number DE89015249/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this paper the thermal equilibrium number of solitons in DNA as a function of absolute temperature and the number of base pairs is calculated. These calculations are effected by modeling DNA as a Toda lattice with parameters chosen to match experimentally measured properties of DNA. It is found that a significant number of solitons is generated at physiological temperature. 23 refs., 2 figs.

43554 Progress in nucleic acid research and molecular biology. Cohn, W.E.; Moldave, K. 295p. Academic Press Complimentary Copy Coordinator, Marketing Dept., San Diego, CA (1988).

Complementary Use of Chemical Modification and Site-Directed Mutagenesis to Probe Structure-Activity Relationships in Enzymes. Mechanisms of the Antiviral Action of Inteferons. Modulation of Cellular Genes by Oncogenes. DNA Damage Produced by Ionizing Radiation in Mammalian Cells: Identities, Mechanisms of Formation, and Reparability. Human Ferritin Gene Expression. Molecular Biology of the Insulin Receptor. Cap-Binding Proteins of Eukaryotic Messenger RNA: Functions in Initiation and Control of Translation. Physical Monitoring of Meiotic and Mitotic Recombination in Yeast. Early Signals Underlying the Induction of the c-fos and c-myc Genes in Quiescent Fibroblasts: Studies with Bombesin and Other Growth Factors. Each chapter includes references.

43555 Synchrotron resource of the Howard Hughes Medical Institute. Staudenmann, J. (Howard Hughes Medical Institute, NSLS X4, Bldg. 725, Brookhaven National Laboratory, Upton, New York 11973-5000 and Department of Electrical Engineering, Columbia University, New York, New York 10032 (US)); Hendrickson, W. A.; Abramowitz, *Review of Scientific Instruments (USA)*, 60(7): 1939-1942 (Jul 1989).

The Synchrotron Resource of the Howard Hughes Medical Institute will be dedicated to structural analyses of biological macromolecules, primarily through crystallography. This facility is under construction at the X4 port of the National Synchrotron Light Source at Brookhaven National Laboratory, and it will comprise three beamlines. The first line to be built has been devised to apply the multiwavelength anomalous diffraction method which provides direct estimates for the phases of reflections. The second line will be devoted to rapid and essentially routine diffraction measurements, mainly through the rotation method. These two experimental stations are contained within refrigerated radiation enclosures that will maintain clean environments, narrowly defined constant temperatures, and protection against biohazard at biosafety level BL-2. At the same time as the second line will be developed, the swath center is planned to first serve as a monitor of the white x-ray beam vertical stability. This project will be done in collaboration with accelerator physicists of the National Synchrotron Light Source. Later, this third line will be equipped for Laue experiments to study, for instance, dynamical processes in proteins.

5503 Cytology

Refer also to citation(s) 43640, 43662

43556 (CONF-8907113–5-Vugraphs) **Protamines in mammalian germ cell mutagenesis.** Sega, G.A. Oak Ridge National Lab., TN (USA). 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 5. international conference on environmental mutagens; 10-15 Jul 1989. Order

Number DE89015367/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In the development from stem cells to functional spermatozoa, the germ cells of all mammals progress through a series of similar stages. Many studies have been carried out in mice with a variety of chemical agents that have produced differential genetic sensitivity in the various germ-cell stages depending on the agent being tested. In studies of the genetic effects of chemical agents in mice, the exposure given to the animals (by injection, inhalation, skin application, etc.) is accurately known. However, in general, nothing is known about the molecular dose of the chemical that actually reaches the different germ-cell stages. In particular, the chemical mutagens ethyl methanesulfonate (EMS), methyl methanesulfonate (MMS), ethylene oxide (EtO) and acrylamide (AA) have all been shown, in genetic studies, to produce very many more dominant lethal mutations and heritable translocations in late spermatids and early spermatozoa than in other germ-cell stages in male mice. We have, subsequently, used all 4 of these chemical mutagens in radioactive form to find out where they are binding within the germ cells and to see what correlations may exist between the extent of chemical binding in different stages and the amount of induced genetic damage. 17 refs., 4 figs.

43557 (PNL–6500-Pt.4, pp. 52-53) **Production of perfused cultures of Chinese hamster ovary cells.** Nelson, J.M.; Metting, N.F.; Braby, L.A. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

Several years ago we discovered that Chinese hamster ovary (CHO) cells could be put into stationary phase by nutritional deprivation, at which time DNA synthetic activity was depressed between 2 and 3 orders of magnitude. At the time that we evaluated the starved plateau-phase CHO cells in detail, we had also noticed that intermittently fed populations never stop cycling at all. We believed that if the cultures could be fed continuously, then the cell density might reach a considerably higher level and the cells arrested by contact inhibition along. Perfused cells should also be more representative of resting cells in vivo because they would not be stressed with respect to nutrient availability. Under these circumstances, we should expect cells to exit the cycle at only one stage, probably just before or after mitosis. To test this possibility, we have attempted to produce plateau-phase cultures of perfused CHO cells using a very low speed peristaltic pump to supply a continuous infusion of nutrient medium to each individual plate. These experiments were met with considerable difficulties. It appears that the demands of this technique exceed the capability of the best commercially available pumping equipment. It also seems unlikely that satisfactory pumping techniques can be developed for continuous perfusion, at a reasonable cost. Consequently, alternative solutions involving the automated frequent feeding, e.g., between 1 and 4 times per day, are currently being investigated.

43558 (UCRL–52000-88-10, pp. 23-29) **Three-dimensional image analysis for studying nuclear chromatin structure.** Dean, P.N. Lawrence Livermore National Lab., CA (USA). Oct 1988. In *Energy and technology review.* Order Number DE89005308/JAW. Available from NTIS, PC A03/MF A01.

A light-microscope-based system for acquiring cross-sectional views of cell nuclei and computer codes to analyze these images and reconstruct the three-dimensional structures they represent were developed. This equipment will be used to study the arrangement of chromosomes in intact cell nuclei,k using fluorescent hybridization to tag individual chromosomes for better visualization. 4 references, 8 figures.

5504 Genetics

Refer also to citation(s) 43554, 44355

5505 Metabolism

Refer also to citation(s) 41801, 43576

43559 (DOE/ER/60575–2) **[Integration of experimental and modeling approaches in the unmanaged ecosystem research plan]: Second year performance report, September 15, 1988–September 14, 1989.** Strain, B.R. Duke Univ., Durham, NC (USA). Dept. of Botany. 15 Jul 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-87ER60575. Order Number DE89015926/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The overall study is an investigation of physiological adaptations in plants grown for long periods in enhanced CO2 levels. The objectives of this research are: to improve the empirical data base of the effect of CO2 and climate variables on plants and ecosystems, paying particular attention to mechanisms of photosynthetic decline and the physiological controls of whole-plant growth, and to contribute new information to an integrated modeling approach for examining the effects of different CO2 and multiple environmental factors on whole plants and ecosystems data will be provided to the improved PRECO and SERECO-type models.

5506 Medicine

Refer also to citation(s) 41784, 43234

43560 **Clinical aspects of neutron capture therapy.** Basic Life Sciences, Vol. 50. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.). 370p. Plenum Press, New York, NY (1988). Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), Upton, NY (USA), 1-2 Feb 1988).

This document contains 36 papers presented at a conference on the current states of boron neutron capture therapy. Topics include radiation dose rates, clinical trials, dose fractionation, therapeutic results, neoplasms, radiation tolerance, and the blood-brain barrier. Individual papers are indexed separately for the data base. (TEM)

43561 (EGG-BNCT–8319) **Non-reactor neutron sources for BNCT [Boron Neutron Capture Therapy].** Dolan, T.J.; Ottewitte, E.H.; Wills, E.E.; Neuman, W.A.; Woodall, D.M. EG and G Idaho, Inc., Idaho Falls, ID (USA). May 1989. 68p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE89016211/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The focus of this study is the indentification of key feasibility issues for the use of non-reactor neutron sources for Boron Neutron Capture Therapy (BNCT). Of the non-reactor neutron sources surveyed, the $^{7}Li(p,n)$ reaction appears to be the most favorable for producing epithermal neutrons for BNCT, and RFQ accelerators are best for producing the desired proton beam. At a proton energy of 2.5 MeV, the total neutron yield is 1.49×10^{-4} neutrons/proton, with a forward energy spectrum extending up to 780 keV and peaked at 500-600 keV. At I = 20 mA, the total neutron yield would be about 1.86×10^{13} neutrons/s. In comparison with a medical therapy fission reactor, the 20 mA accelerator system has a flux intensity at least 5 times lower, requiring an irradiation time at least 5 times longer, a much higher gamma intensity, which would probably require additional shielding, further reducing the neutron intensity, 30% of the neutrons above 15 keV, resulting in a higher fast neutron dose to healthy tissue, poorer spatial uniformity of the neutron beam, and greater angular divergence of the neutron beam, resulting in a rapid decrease of flux with distance from the filter. The possibility of overcoming these limitations by using more shielding and a higher beam current needs further study. RFQ accelerator technology is being developed to provide the desired proton beam parameters. The effects of neutron beam energy spectra, beam contaminants, angular divergence, spatial variation, and beam rotation around the tumor need to be studied in detail, in order to evaluate the feasibility of accelerator-produced neutrons for BNCT. 41 refs., 20 figs., 8 tabs.

43562 (IAEA-TECDOC–501) **Atlas of liver imaging. A compendium of liver images used in a co-ordinated research programme on evaluation of nuclear medicine imaging procedures for the diagnosis of liver diseases.** International Atomic Energy Agency, Vienna (Austria). May 1989. 228p. Order Number

DE89635283/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

This atlas is an outcome of an IAEA co-ordinated research programme. In addition to Japan, nine other Asian countries participated in the project and 293 liver scintigrams (116 from Japanese institutions and 177 from seven Asian countries) were evaluated by physicians from the participating Asian countries. The computer analysis of the scan findings of the individual physicians was carried out and individual scores have been separately tabulated for: (a) scan abnormality; (b) space occupying lesions; (c) cirrhosis and (d) diffuse liver diseases like hepatitis. Refs, figs and tabs.

43563 (INIS-mf–11503, pp. 7) **Diagnostic imaging with ^{99m}Tc labelled pharmaceuticals.** Weininger, J. (Soreq Nuclear Research Center, Yavne (Israel). Dept. of Radiopharmaceuticals). Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989*. Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Summary only.

43564 (INIS-mf–11503, pp. 92-95) **Low boron concentration measurements for neutron capture therapy.** Shani, G. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering); Groff, Y.; Marcus, S.; Chipman, D.; Quastel, M.R. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989*. Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Summary only.

43565 (INIS-mf–11503, pp. 118-120) **Image quality and breast dose at mammography centers in Israel. Preliminary results of the first survey.** Faermann, S. (Soroka Medical Center, Beersheba (Israel). Dept. of Oncology); Krutman, Y.; Tsehanski, A.; Tatcher, M.; Lichter, A. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989*. Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Summary only.

43566 (JINR–18-88-392) **Forming and study of a high energy neutron beam from JINR phasotron.** Abazov, V.M.; Gustov, S.A.; Zielczynski, M. and others. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 14p. (In Russian). Order Number DE89635378/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

First results are presented on forming the therapeutic neutron beam at mean energy of a few hundred MeV. THe beam is obtained from thick target bombarded with 660 MeV protons extracted from the conversed proton at the Laboratory of Nuclear Problems, JINR. The optium target is selected. Determination of absolute value of absorbed dose and spatial dose distribution in a water phantom are considered. It is shown that the geometrical distribution of dose absorbed in phantom for the high energy neutron beam is practically the same as for a broad therapeutic beam of protons, but using of the neutron beam promises in some cases a therapy gain due to overcoming of radioresistency of hypoxic cancer cells. 28 refs.; 8 figs.; 1 tab.

43567 (ORNL/FTR–3332) **[Equipment requirements for vaccine refrigeration, Rabat and Marakech, Morocco, June 1989]: Foreign trip report.** Durand, J.M. Oak Ridge National Lab., TN (USA). 10 Jul 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89016158/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The consultant traveled to Morocco to assess the equipment requirements for the vaccine cold chain, comparing the need for additional absorption refrigeration systems with the financial viability of a conversion to photovoltaic powered vapor compression equipment. The consultant found that bottled gas has proven to be a cost effective and available fuel and moreover can be used very effectively for sterilization purposes in rural health clinics. Unless they could be introduced in groups of 50 systems or more in concentrated areas, photovoltaic systems were not seen as a viable alternative to gas fueled absorption systems, due to higher life cycle costs and to the absence of a maintenance network. Introduction of PV systems were recommended for lighting purposes, however, to supplement the energy uses in rural clinics.

43568 (PB–89-167183/XAB) **Principles of particle radiography and possible medical application.** Jones, D.T.L. Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre. 1987. 21p. (NAC–87-05). Available from NTIS, PC EE04/MF E04.

North American Continent sales only.

Beams of neutrons from the p(66 MeV)/Be reaction and protons (up to 200 MeV) will be available at the NAC for medical applications. The principles of neutron and proton radiography are discussed. It is concluded that proton radiography may have some applications in the medical field, while neutron radiography will be of little use.

43569 (PB–89-193858/XAB) **NBS (National Bureau of Standards) measurement services: calibration of gamma-ray-emitting brachytherapy sources. Final report.** Weaver, J.T.; Loftus, T.P.; Loevinger, R. National Bureau of Standards, Washington, DC (USA). Center for Radiation Research. Dec 1988. 63p. (NBS/SP–250/19). Available from NTIS, PC A04/MF A01.

Also available from Supt. of Docs. as SN003-003-02923-8. Library of Congress catalog card no. 88-600609.

The calibration of small radioactive sources used for interstitial radiation therapy, short-distance therapy (brachytherapy), is performed in terms of the physical quantities exposure or air kerma. (60)Co and (137)Cs sources are calibrated by comparison with NBS working standard sources of the same type, while (192)Ir and (125)I sources are calibrated by measurement in a reentrant ionization chamber that was calibrated using NBS working standard sources of the same type. The working standard sources were calibrated using the NBS graphite cavity ionization chambers except for (125)I, for which the NBS measurement standard was a free-air chamber. The working standard sources of the two long-lived sources have been measured a number of times over the years; the reliability of the reentrant chamber for the two short-lived sources is assured by use of sealed radium sources as a constancy check. The overall uncertainty (considered to have the approximate significance of a 95% confidence limit) is given as 2% for all the sources except for (125)I seeds, for which it is given as 5%, 6%, and 7%, depending on the type of seed. The stated uncertainty for (125)I seeds does not include possible errors due to low-energy X rays not recognized at the time the standards were established.

43570 Detection and treatment of occult metastases with radiolabeled monoclonal antibodies. Raventos, A. (Univ. of California, Davis, CA (US)); DeNardo, S.J.; DeNardo, G.L. pp. 247 of Occult nodal metastasis in solid carcinomata. Moloy, P.J.; Nicolson, G.L. Praeger Publications Inc., New York, NY (1987).

Monoclonal antibody (MAb) technology is entering its second decade already well established as an important tool of science, and many clinical applications are under investigation. Among these is tumor imaging, using radiolabeled MAbs. The radiochemistry of labeling antibodies with preservation of immunoreactivity has been developed for several elements including indium (In) and iodine (I) and is under development for copper, bromine, yttrium, technetium, rhenium, and astatine. Each has advantages and disadvantages; different radionuclides are optimum for different situations. Several dozen MAbs to carcinomas are in regular production and are shared among investigating laboratories. Virtually all of them show pancarcinoma reactivity; that is, they bind to a broad class of carcinomas. Only rarely does one MAb react with all carcinomas from a particular organ site.

43571 New radiohalogenated alkenyl tellurium fatty acids. Srivastave, P.C. (Oak Ridge National Laboratory, TN (USA)); Knapp, F.F. Jr.; Kabalka, G.W. *Phosphorus and Sulfur and the Related Elements (UK)*, 38(1-2): 49-58 (Jul 1988). DOE Contract

AC05-84OR21400. (CONF-8708173--: 5. international symposium on the chemistry of selenium and tellurium, 24-28 Aug 1987).

Radiolabeled long-chain fatty acids have diagnostic value as radiopharmaceutical tools in myocardial imaging. Some applications of these fatty acids are limited due to their natural metabolic degradation in vivo with subsequent washout of the radioactivity from the myocardium. The identification of structural features which will increase the myocardial residence time without decreasing the heart uptake of long-chain fatty acids is of interest. Fatty acids containing the tellurium heteroatom were the first modified fatty acids developed and show unique prolonged myocardial retention and low blood levels. Our detailed studies with radioiodinated vinyliodide substituted tellurium fatty acids demonstrate that heart uptake is a function of the tellurium position. New techniques of tellurium and organoborane chemistry have been developed for the synthesis of a variety of radioiodinated iodoalkenyl tellurium fatty acids.

43572 A multigrid expectation maximization reconstruction algorithm for positron emission tomography. Ranganath, M.V. (9508070); Dhawan, A.P.; Mullani, N. *IEEE Transactions of Medical Imaging (USA)*, 7(4): 273-278 (Dec 1988).

The problem of reconstruction in positron emission tomography (PET) is basically estimating the number of photon pairs emitted from the source. Using the concept of the maximum likelihood (ML) algorithm, the problem of reconstruction is reduced to determining an estimate of the emitter density that maximizes the probability of observing the actual detector count data over all possible emitter density distributions. A solution using this type of expectation maximization (EM) algorithm with a fixed grid size is severely handicapped by the slow convergence rate, the large computation time, and the non-uniform correction efficiency of each iteration making the algorithm very sensitive to the image pattern. An efficient knowledge-based multigrid reconstruction algorithm based on the ML approach is presented to overcome these problems.

43573 X-ray microtomography with monochromatic synchrotron radiation. D'Amico, K. L. (Corporate Research Laboratories, Exxon Research and Engineering Company, Annandale, New Jersey 08801 (US)); Deckman, H. W.; Dunsmuir, J. H.; Flannery, B. P.; Roberge, W. G. *Review of Scientific Instruments (USA)*, 60(7): 1524-1526 (Jul 1989).

We review results obtained with the Exxon Microtomography apparatus. The technique is based on tomographic methods widely used in medicine and nondestructive evaluation. When used with a tunable x-ray source, it is a powerful diagnostic and research tool for a wide variety of materials problems. It is capable of producing maps of the interior structure and chemical composition of samples approximately 0.5–1.0 mm in size, with spatial resolution in the map of the density variations approaching 10.0 μm.

43574 Coronary angiography using synchrotron radiation. Thompson, A. C. (Center for X-Ray Optics, Lawrence Berkeley Laboratory, Berkeley, California 94720 (US)); Rubenstein, E.; Zeman, H. D.; Hofstadter, R.; Otis, J. N.; Giacomini, J. C.; Gordon, H. J.; Brown, G. S. *Review of Scientific Instruments (USA)*, 60(7): 1674-1679 (Jul 1989). DOE Contract FG03-87ER60527.

Imaging of coronary arteries using a venous instead of an arterial injection of contrast agent could provide a much safer method to diagnose heart disease. The tunability, intensity, and collimation of synchrotron radiation x-ray beams makes possible imaging systems with greatly improved imaging sensitivity. A pair of fan x-ray beams, a movable patient chair, and a multielement x-ray detector are used to acquire a pair of x-ray images above and below the iodine *K* edge. The logarithmic subtraction of these two images produces an image with excellent sensitivity to contrast agent and minimal sensitivity to bone and tissue. High-quality images from a dog and preliminary images from five humans have been obtained. Improvements are being made to the system to increase the effective radiation flux and to measure the position of both x-ray beams.

5507 Microbiology

Refer also to citation(s) 41427

43575 (DOE/ER/60685–2) **Improvement of the subsurface microbial culture collection: Progress report.** Balkwill, D.L. Florida State Univ., Tallahassee, FL (USA). Dept. of Biological Science. 15 Aug 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER60685. Order Number DE89016154/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This report summarizes progress made in our laboratory toward completion of the experimental plan for our ongoing DOE grant project entitled "Improvement of the Subsurface Microbial Culture Collection". A copy of the experimental plan from our original proposal for this grant is provided in Appendix I. The initial funding period for the aforementioned grant ran from May 15, 1988 through December 14, 1988. On August 15, 1988, we submitted a continuation request for the second (and current) funding period (December 15, 1988 through December 14, 1989). A copy of the experimental plan from the continuation proposal is provided in Appendix II. On August 15, 1988, we also submitted a progress report on work completed from the start of the grant through that date. A copy of this report (DOE/ER/60685–1) is provided in Appendix III. The current report (DOE/ER/60685–2), then summarizes the work that we completed between August 15, 1988 (The date of the previous report) and August 15, 1989 (the date of the current report). Most of this work was performed during the second funding period of the grant, although a small portion of it occurred during the last part of the first funding period. The report below distinguishes between the two funding periods.

43576 (EGG-M–88344) **Genetics of acidophilic, heterotrophic bacteria.** Ward, T.E.; Bruhn, D.F.; Watkins, C.S.; Rowland, M.L.; Bulmer, D.K.; Winston, V. EG and G Idaho, Inc., Idaho Falls, ID (USA); Idaho State Univ., Pocatello, ID (USA). [1988]. 16p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC07-76ID01570. (CONF-8808104–3: DOE Office of Fossil Energy workshop on bioprocessing of coals, 15-18 Aug 1988). Order Number DE89016212/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The genetic characteristics of members of the genus Acidiphilium are poorly understood. As part of our study of the genetics of these bacteria, a search was made for an inducible, lysogenic bacteriophage. Such a bacteriophage has been discovered. Several properties of the phage have been investigated. The phage has a lambdoid morphology and is somewhat larger than lambda. A variety of factors which affect phage stability have been investigated. The bacteriophage infects several of the strains that have been tested. Study of this bacteriophage should greatly increase our understanding of genetic mechanisms in Acidiphilium. 23 refs., 3 figs., 1 tab.

43577 Production of foods, food additives and feeds from biomass by microbiological processes. Litchfield, J.H. (Battelle-Columbus Labs., Columbus, OH (US)). vp. of Biomass conversion technology. Moo-Young, M. Pergamon Books Inc., Elmsford, NY (1987).

Availability and cost of n-alkane substrates was a significant factor in the commercial failure of the British Petroleum and the Kanegafugi Chemical Industry Co. processes for large scale production of Candida spp. for use in animal feeds. Regulatory problems associated with hydrocarbon residues in the final microbial protein products were also a problem in these processes. In contrast, biomass resources including agricultural, food processing waste and forestry products and their wastes are attractive low-cost sources of carbohydrate raw materials for producing foods, food additives and feeds by microbiological conversion processes. This discussion covers developments in the production of food and feed-grade microbial protein products (single cell proteins) and selected food additives from biomass-derived carbohydrates by nonphotosynthetic microorganisms including actinomycetes, bacteria, molds, yeasts, and higher fungi.

5509 Pathology

Refer also to citation(s) 43652, 43673

5510 Physiological Systems

Refer also to citation(s) 43575

5520 Public Health

Refer also to citation(s) 41500, 41501, 41503, 41576, 43373, 43374, 43375, 43376, 43377, 43378, 43380, 43382, 43384, 43385, 43386, 43387, 43388, 43390, 43391, 43392, 43393, 43394, 43395, 43396, 43639, 43641, 43642, 43663

43578 (PB–89-182042/XAB) **Development and validation of methods for sampling and analysis of workplace toxic substances. Research report.** Gunderson, E.C.; Anderson, C.C.; Smith, R.H.; Doemeny, L.J. SRI International, Menlo Park, CA (USA). Sep 1980. 60p. Available from NTIS, PC A04/MF A01.

Methods for sampling and analyzing 130 toxic workplace substances were evaluated. Analytical methods were developed and tested for the toxic substance. The sensitivity and specificity of the method were evaluated and the response to known interferences was determined. An appropriate sample-collection medium was chosen and spiked with known amounts of the test substance. An efficient recovery procedure was developed. The analytic recovery of the substance from the sampling medium was then determined and the precision was evaluated. The efficiency of the sampling procedure with known air concentrations of the toxic substance was tested.

5530 Agriculture and Food Technology

Refer also to citation(s) 41562, 41634, 41635, 43397, 43577

43579 (AECL–9062) **Preservation of fish and fish products by use of ionizing radiation. A literature review.** Chuaqui-Offermanns, Noemi. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. Sep 1986. 56p. Order Number DE89635240/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

This report reviews the use of the radurization process in the preservation of fish and fish products. The literature describes several aspects of the process such as the fish species and the doses required, the wholesomeness of the radurized fish, and recommendations by international authorities on the applicability of the process. Areas of further research have been identified. The report concludes that radurization is an effective process for extending the shelf life of fish and fish products. Doses ranging from 0.75 to 2.5 kGy extend the shelf life two to three times compared to unirradiated controls. The loss of nutritional value at these doses is insignificant, and no deleterious short- or long-term toxicological effects have been detected in studies on animals. However, further study is required on consumer acceptance, economic feasibility, and radiation sensitivity of parasites in fish and fish products. 159 refs.

43580 (AECL–9081) **Insect pests of stored grain products. A review.** Chuaqui-Offermanns, N. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 78p. Order Number DE89635241/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The presence of insects in stored products is a worldwide recognized problem. In this report chemical and physical methods to control insect infestations in stored products are discussed. Special attention is given to the use of ionizing radiation to control insect pests in stored grains. The radiosensitivity of the most common insect pests at their different developmental stages is presented and discussed. The conclusions of this review are compiled in an executive summary. 62 refs.

43581 (IAEA-TECDOC–490, pp. 77-94) **Regulatory control of food irradiation processes.** Engel, R.E. (Department of Agriculture, Washington, DC (USA). Food Safety and Inspectione Service); Derr, D.D. International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8804282–: Task force meeting on public information of food irradiation, Cadarache (France), 18-21 Apr 1988). In *Safety factors influencing the acceptance of food irradiation technology. Report of a task force meeting on public information of food irradiation convened by the International Consultative Group on Food Irradiation and held in Cadarache, France, 18-21 April 1988.* Order Number DE89619871/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

Ionizing radiation has a long history of successful use in treating a variety of nonfood products, but its application to foods is a new challenge. In order to meet this challenge, regulatory requirements and standards for the irradiation treatment of foods are needed. Many countries have already established rules and protocols for the use of ionizing radiation on a variety of food products and the food industry has recognized the need for standards for the irradiation treatment of foods, in many cases more stringent than those applied for other processes. While standardization and control of the irradiation process are imperative for its proper application to food, they are not the parameters that will govern the successful implementation and acceptance of food irradiation. The technology will be successful only if the public accepts it as a safe and useful process. Recent surveys show that dissemination of accurate and complete facts about irradiation is a key to public education about the technology. The United States Department of Agriculture (USDA) agrees that public information is important and, while it feels that industry must play the primary role, it is participating in several public information activities. Many U.S. government agencies are involved in food irradiation, protecting the public from hazards associated with ionizing radiation technology, monitoring the safety and wholesomeness of the food supply, and developing and transferring the technology to the private sector. There are only a few approved uses of food irradiation in the U.S. at the present time and very little food is being processed using the technology. The regulatory agencies are requiring proper labeling and packaging, and effective quality control systems as prerequisites for the use of irradiation. Methods for detecting if a food has been irradiated are also under development.

43582 (INIS-mf–11494, pp. 57) **Irradiation of kiwifruit.** Wheeler, D.R. (Auckland Univ. (New Zealand). Dept. of Chemistry); Packer, J.E.; Stewart, A.; Ferguson, A.R. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1988. (CONF-8811246–: 14. AINSE radiation chemistry conference, Lucas Heights (Australia), 9-11 Nov 1988). In *14th AINSE radiation chemistry conference : conference handbook (programme, abstracts and general information).* Order Number DE89632645/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Published in summary form only.

43583 (INIS-mf–11503, pp. 121-124) **Radiation sterilization. Modification of radiation response of bacillus pumilus spores in antibiotic powders.** Jacobs, G.P. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

In view of the application of ionizing radiation to sterilize pharmaceutical products, and the particular advantages of using this mode of sterilization for powders for injection, which cannot be sterilized by more conventional methods, it is important to recognise the possibility of modification of radiation response of bacteria when in close contact with various drug powders. For this study, bacterial spores, which lend themselves to dessication, and which can be dried onto an inert powder matrix, were chosen as the test system. The results of this work indicate that the additives tested have a modest protective effect on the spores. However, when considering a bacterial inactivation for sterilization purposes of between six and ten orders of magnitude, that is, a desired sterility assurance level of an expected maximum probability of a product item being nonsterile of 10^{-6}, then the slight protective effect observed in this study approaches insignificance.

43584 (Juel–2253) **Uptake of [^{14}C]triadimenol via grain and root after seed treatment of winter barley with a flowable seed dressing: Influence of soil moisture and sowing date on the distribution of radioactivity and active ingredient content in plant and soil.** Schneider, M. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Radioagronomie; Bonn Univ. (Germany, F.R.). Dec 1988. 207p. (In German). Order Number DE89911078/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Winter barley seed of the 'Vogelsander Gold' variety was shown in a total of 7 lysimeters after seed treatment with [benzene ring-U-^{14}C]triadimenol in the formulation as [^{14}C]Baytan 075 FS and [^{14}C]Baytan 25 DS at an early (September) and a late date (October). After both dates of sowing, the FS-treated winter barley developed under 3 different soil moisture conditions. The radioactivity and active ingredient contents in plants and soil were recorded until tillering as a function of low, high and natural precipitation after sowing. Details on the uptake of radioactivity via grain and roots were quantitatively and qualitatively studied in two further lysimeters, a pot experiment as well as experiments in the growth chamber. The results are presented and discussed in detail. (orig./MG).

43585 (NIRS-RSD–83) **Radioactivity survey data in Japan, part 2. Dietary materials.** National Inst. of Radiological Sciences, Chiba (Japan). Oct 1988. 38p. Order Number DE89906612/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report presents data obtained through a radioactivity survey, various environmental and dietary materials are collected for analysis. Rain and dry fallout are collected monthly. Airborne dust is collected every three months. Service water samples are taken semiyearly at the intake of watertreatment plants and at the tap. Freshwater is taken once a year (fishing season). Soil samples are collected once a year from two layers at different depths. Sea water is collected once a year at fixed stations where the effect of terrestrial fresh water from rivers is expected to be negligible. Sea sediments are collected once a year in the same area as that for the sea water sample. A full one day ordinary diet including three meals, water and tea for five persons is collected semiyearly as a sample of 'total diet'. Polished rice is collected in producing districts and in consuming areas. Raw milk is collected in producing districts and commercial milk is purchased in consuming districts. Vegetable are collected semiyearly in producing and consuming districts. Tea samples are also collected semiyearly. Fish, shellfish and seaweeds are collected once a year. Test solutions are prepared from these samples. Strontium-90 and cesium-137 are separated and subjected to quantitative determination. Results obtained are tabulated. (N.K.).

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Refer also to citation(s) 42087, 42671, 42823, 42824, 42842, 42844, 43554, 44039

43586 (AD-A–205803/0/XAB) **Characterization of radiation-induced emesis in the ferret.** King, G.L. Armed Forces Radiobiology Research Inst., Bethesda, MD (USA). 1988. 15p. (AFRRI-SR–88-41). Available from NTIS, PC A03/MF A01.

Pub. in Radiation Research, Vol. 114, 599-612(1988).

Forty-eight ferrets (Mustela putorius furo) were individually head-shielded and radiated with bilateral cobalt 60 gamma radiation at 100 cGy min at doses ranging between 49 and 601 cGy. The emetic threshold was observed at 69 cGy, the ED 50 was calculated as 77 cGy, and 100% incidence of emesis occurred at 201 cGy. With increasing doses of radiation, the latency to first emesis after radiation decreased dramatically, whereas the duration of the prodromal period increased. Two other sets of experiments suggest that dopaminergic mechanisms play a minor role in radiation-induced emesis in the ferret. Twenty-two animals were injected either intravenously or subcutaneously with 30 to 300 micrograms /kg of apomorphine. Fewer than 50% of the animals vomited to 300 micrograms/kg apomorphine; central dopaminergic receptor activation was apparent at all doses. Another eight animals received 1 mg/kg domperidone prior to either 201 (n=4) or 401 (n=4) cGy radiation and their emetic responses were compared with NaCl-injected-irradiated controls (n=8). At 201 cGy, domperidone significantly reduced only the total time in emetic behavior. At 401 cGy, domperidone had no salutary effect on radiation-induced emesis. The emetic responses of the ferret to radiation and apomorphine are compared with these responses in other vomiting species.

43587 (AD-A–205804/8/XAB) **Tethered-restraint system for blood collection from ferrets.** Jackson, R.K.; Kieffer, V.A.; Sauber, J.S.; King, G.L. Armed Forces Radiobiology Research Inst., Bethesda, MD (USA). Oct 1988. 5p. (AFRRI-SR–88-40). Available from NTIS, PC A02/MF A01.

Pub. in Laboratory Animal Science, Vol. 38, No. 5, 625-628(Oct 1988).

The laboratory ferret, Mustela putorius furo, recently has come into prominence as a laboratory animal for use in biomedical research. This laboratory has adopted the use of this species because the ferret's emetic response to radiation occurs at a lower dose and has a more rapid onset than that of dogs. One approach for determining the physiological basis of this response is to measure serum levels of various circulating substances before and after irradiation. However, blood collection from the ferret can be difficult because the lack of easily accessible veins and seasonal accumulation of subcutaneous body fat. This report describes a method of tethered-restraint for the ferret in which an in-dwelling venous jugular catheter is implanted for withdrawing blood samples. No interference with the animal's normal activities occurs during the sampling procedure. Each animal is conditioned to the tethered-restraint prior to surgical placement of the catheter. The technique provides a minimally stressful method of restraint. A similar tethering system has been used successfully on several other animal species, such as non-human primates and rats.

43588 (AD-A–205805/5/XAB) **Attenuation of a radiation-induced conditioned taste aversion after the development of ethanol tolerance.** Hunt, W.A.; Rabin, B.M. Armed Forces Radiobiology Research Inst., Bethesda, MD (USA). 1988. 9p. (AFRRI-SR–88-39). Available from NTIS, PC A02/MF A01.

Pub. in Life Sciences, Vol. 43, 59-66(1988).

An attempt to reduce a radiation-induced conditioned taste aversion (CTA) was undertaken by rendering animals tolerant to ethanol. Ethanol tolerance, developed over 5 days, was sufficient to block a radiation-induced taste aversion, as well as an ethanol-induced CTA. Several intermittent doses of ethanol, which did not induce tolerance but removed the novelty of the conditioning stimulus, blocked an ethanol-induced CTA but not the radiation-induced CTA. A CTA induced by doses of radiation up to 500 rads was attenuated. These data suggest that radioprotection developing in association with ethanol tolerance is a result of a physiological response to the chronic presence of ethanol not to the ethanol itself.

43589 (AD-A–205806/3/XAB) **Effect of PGE2 on radiation response of chinese hamster V79 cells in vitro.** Holahan, E.V.; Blakely, W.F.; Walden, T.L. Armed Forces Radiobiology Research Inst., Bethesda, MD (USA). 1987. 11p. (AFRRI-SR–88-38). Available from NTIS, PC A03/MF A01.

Pub. in Prostaglandin and Lipid Metabolism in Radiation Injury, 253-262(1987).

Several recent investigations have reported that 16,16-dimethyl prostaglandin E2 (DiPGE2) can protect murine intestinal epithelial cells and hematopoietic stem cells (CFU-S) in vivo from ionizing radiation. It has been postulated that PGE2 may also increase radiation resistance in vitro by stimulating free-radical scavenging or repair systems for oxidative damage. This study reports on the effect of PGE2 in modifying radiation sensitivity in an in vitro mammalian cell line. Chinese hamster V79A03 cells were cultured. Exponentially growing cells were incubated before exposure to graded doses of 250-kVp X rays. Cells were assayed for variations in intracellular levels of cyclic 3',5'-adenosine monophosphate (cAMP), total protein, and glutathione (GSH), and radiation sensitivity was measured by cell survival before and after PGE2 treatment. An acute (2-hr) exposure induced a 25% increase in cAMP content with no significant change in intracellular GSH or protein and no effect on cell survival after exposure to radiation. Chronic exposure to PGE2 increased intracellular GSH, protein, and cAMP levels by 82%, 3%, and 74%, respectively. However, no increase in radiation resistance was apparent following chronic exposure to PGE2. The increased radiation resistance observed in vitro may be due to modifications such as localized tissue or organ-system hypoxia.

43590 (AD-A-205807/1/XAB) **Flow-cytometry techniques in radiation biology.** McCarthy, K.F.; Hale, M.L. Armed Forces Radiobiology Research Inst., Bethesda, MD (USA). 1988. 16p. (AFRRI-SR-88-42). Available from NTIS, PC A03/MF A01.

Pub. in Toxicology Letters, Vol. 43, 219-233(1988).

Considerable evidence exists that all blood cells are derived from HSC. These cells are of interest to radiobiologists because they are highly sensitive to low doses of ionizing radiation. Hematopoietic stem cells (HSC) are present in the marrow at a concentration of approximately 2-3 HSC per 1000 nucleated marrow cells. In the past, only clonogenic assays requiring 8-13 days and ten irradiated recipient rodents were available for assaying HSC. Because of the importance of HSC in the post-irradiation syndrome, the authors developed a new rapid method based on flow cytometry not only to assay but also to purify and characterize HSC. This new method makes extensive use of non-clonal antibodies conjugated to fluorescent phycobiliproteins through the sulfhydryls of the hinge region of the IgG molecule. An optical bench arrangement with a dye laser and an argon laser was used for dual excitation of the phycobiliprotein-monoclonal antibody conjugates and various cellular and DNA probes. Using 4', 6-diamidino 2-phenylindole dihydrochloride (DAP) exclusion to identify viable cells, it was possible to follow regeneration of post-irradiated rat marrow HSC.

43591 (AD-A-205810/5/XAB) **Recovery of hematopoietic colony-forming cells in irradiated mice pretreated with interleukin 1 (IL-1).** Schwartz, G.N.; Neta, R.; Vigneulle, R.M.; Patchen, M.L.; MacVittie, T.J. Armed Forces Radiobiology Research Inst., Bethesda, MD (USA). 1988. 8p. (AFRRI-SR-88-46). Available from NTIS, PC A02/MF A01.

Pub. in Experimental Hematology, Vol. 16, 752-757(1988).

Data in this report determined the effect of a single injection of recombinant interleukin 1 a (rIL-1) prior to irradiation of B6D2F1 mice on the recovery of colony-forming cells (CFC) at early and late times after sublethal and lethal doses of radiation. Injection of rIL-1 promoted an earlier recovery of mature cells in the blood and CFC in the bone marrow and spleen. For example, 8 days after 6.5-Gy irradiation, the number of CFU-E (colony-forming units erythroid), BFU-E (burst-forming units-erythroid), and GMCFC (granulocyte-macrophage colony-forming cells) per femur was approximately 1.5-fold higher in rIL-injected mice than in saline-injected mice. Also, 5, 9, and 12 days after irradiation, the number of both day 8 and day 12 CFU-S (colony-forming units-spleen) was almost twofold greater in bone marrow from rIL1-injected mice. The earlier recovery of CFU-S in rIL-1 injected mice was not associated with an increase in the number of CFU-S that survived immediately after irradiation. Also, 7 months after irradiation, the number of CFU-S per femur of both saline-and rIL-1 injected mice was still < 50% of normal values. Data in this report demonstrate that a single injection of rIL-1 prior to irradiation accelerates early hematopoietic recovery in irradiation mice, but does not prevent expression of radiation-induced front-end damage damage to hematopoietic tissues.

43592 (AD-A-205812/1/XAB) **Radiation-induced impairment of neuronal excitability.** Pellmar, T.C.; Tolliver, J.M.; Neel, K.L. Armed Forces Radiobiology Research Inst., Bethesda, MD (USA). 1988. 12p. (AFRRI-SR-88-45). Available from NTIS, PC A03/MF A01.

Pub. in Comments Toxicology, Vol. 2, No. 4, 253-263(1988).

Radiation causes a decrease in the synaptically evoked activity of CA1 hippocampal pyramidal cells. This effect is dose and dose-rate dependent. Hydrogen peroxide, which produces hydroxyl free radicals when combined with FE + 2, produces similar damage. In contrast, the radioprotectant, dithiothreitol, increases the excitability of hippocampal neurons. These studies indicate that radiation can directly affect the function of central neurons.

43593 (AD-A-205813/9/XAB) **Comparison of in vivo effects of human recombinant IL 1 and human recombinant IL 6 in mice.** Neta, R.; Vogel, S.N.; Sipe, J.D.; Wong, G.G.; Nordan, R.P. Armed Forces Radiobiology Research Inst., Bethesda, MD (USA). 1988. 11p. (AFRRI-SR-88-44). Available from NTIS, PC A03/MF A01.

Pub. in Lymphokine Research, Vol. 7, No. 4, 403-412(1988).

Interleukin 1 and Interleukin 6 share a number of biological activities, including induction of fever, neutrophilia and acute phase response, and IL 1 induces IL 6 production by fibroblasts and macrophages. Therefore, it was proposed that IL 6 mediates many of the activities of IL 1. To test this hypothesis in vivo, the authors assessed induction of IL 6 following IL 1a administration to mice and tested IL 6 for radioprotection and induction of early (CSF) and late (fibrinogen and SAA) acute phase reactants. Unlike IL 1 which is radioprotective when administered in doses above 100 ng/mouse, doses of 10-1000 ng/mouse of human recombinant IL 6 did not result in increased survival of mice following lethal irradiation. Such treatment given 20 hrs before LD 50/30 doses of radiation resulted in reduced survival of mice. However, IL 6 augmented the radioprotective effect of IL 1. IL 1 in doses above 10 ng/mouse induced within 2 to 6 hrs a dose-dependent increase in CSF in circulation, but IL 6 did not induce detectable levels of CSF at 2, 6 and 20 hrs after administration. Administration of IL 6 to mice produced a dose-dependent increase in circulating fibrinogen and SAA. Similarly, administration of IL 1 resulted in much greater increases in levels of fibrinogen and SAA. Therefore, IL 1 is a more-effective inducer of fibrinogen and SAA in mice than is IL 6.

43594 (AD-A-205814/7/XAB) **Effects of sublethal doses of ionizing radiation on schedule-controlled performance in rats.** Mele, P.C.; Franz, C.G.; Harrison, J.R. Armed Forces Radiobiology Research Inst., Bethesda, MD (USA). 1988. 9p. (AFRRI-SR-88-43). Available from NTIS, PC A02/MF A01.

Pub. in Pharmacology Biochemistry and Behavior, Vol. 30, 1007-1014(1988).

Male rats responded under a fixed-ratio (FR) 50 or a fixed-interval (FI) 120-sec schedule of milk delivery. Separate groups were acutely exposed to 0.5, 1.5, 4.5, or 0 (FI only) Gray (Gy) of cobalt-60 gamma radiation 3 times at 43-day intervals. All rats received an acute dose of 6.5 Gy 64 days after the last of these exposures. One-half and 1.5 Gy did not alter FR or FI performance significantly. After 4.5 Gy, no observable changes in performance occurred within 1 hr of exposure. Maximal reductions in FR response rates occurred 24 hr after exposure and recovery followed over the subsequent 72 hr. Post-reinforcement pause was increased and running response rate was decreased by 4.5-Gy. Similar effects were found after each 4.5-Gy exposure. In contrast, FI performance (overall response rate, post-reinforcement pause, running response rate, index of curvature) was not altered reliably by 4.5-Gy. Both FR and FI response rates were reduced by 6.5 Gy beginning 24 hr after exposure; FR rates tended to be reduced more than FI rates 24-72 hr after exposure. Response rates under both schedules recovered gradually over 7 weeks. The behavioral effects of 6.5 Gy did not vary as a function of irradiation history. In contrast, irradiation history affected survival in that 4/9 rats previously exposed to 4.5 Gy died during weeks 4-5 after 6.5 Gy, whereas there were no deaths in the rats previously exposed to lower doses. Radiogenic disruption of operant performance was dose-related, reversible, non-cumulative, and dependent on the schedule of reinforcement.

43595 (AD-A-205818/8/XAB) **Biological evaluation of radioprotective drugs. Final report, 1 February 1986-30 September 1988.** Murray, D. Anderson (M.D.) Cancer Center, Houston, TX (USA). 1 Nov 1988. 54p. Available from NTIS, PC A04/MF A01.

The cellular and molecular mechanisms of radioprotection by aminothiols were investigated through the use of cultured mammalian (CHO) cells and a whole-animal model, specific-pathogen free mice. For each of these systems, detailed structure-activity relationships were determined relating the effects of the different drugs on various endpoints for the survival of clonogenic cells and on the induction and repair of several types of DNA lesions in these same cells. The data with cultured cells were used as a means of understanding or predicting the effects of the phosphate-blocked derivatives of these thiols on tissues. The major finding from the in vitro studies is the fact that the modulation of cell survival and DNA double-strand break induction correlates closely for a series of structurally-different thiols and aminothiols. The in vivo studies suggest that tissue oxygenation plays an important role in determining both the extent and mechanism of protection, and that understanding the interrelationships between oxygen, aminothiols and radiation sensitivity will be a crucial step in the ability to utilize such drugs effectively.

43596 (AD-A-206531/6/XAB) **AFRRI (Armed Forces Radiobiology Research Institute) reports, October, November, December 1988. Technical report.** Armed Forces Radiobiology Research Inst., Bethesda, MD (USA). Oct 1988. 200p. Available from NTIS, PC A09/MF A01.

Set Includes Rept. nos. AFRRI-SR88-30 through AFRRI-SR88-49.

This volume contains AFRRI Scientific Reports SR88-30 through SR88-49 for Oct-Dec 1988.

43597 (DOE/ER/60531–1) **Screening models to predict food-chain transfer of environmental toxicants: Final report.** Johnson, J.E.; Ward, G.M. Colorado State Univ., Fort Collins, CO (USA). 31 Mar 1989. 22p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER60531. Order Number DE89016448/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objectives of the research effort were to determine transfer coefficients to milk, beef, eggs, and poultry meat of six radionuclides for which transfer coefficients were either undetermined or based upon secondary data. The radionuclides were isotopes of Tc, Mo, Te, Ba, Zr, and Nb. In addition, ^{131}I was used in experiments with hens to determine egg and poultry meat transfer coefficients. The new information on transfer coefficients obtained during this project indicates that, in some cases, lower values are appropriate and that those currently in use may provide an overestimate of the risks to man from the animal food chain. The objective of the second phase of this research was to provide information to clarify the physiological parameters that control transfer of radionuclides to animal food products. The data from the first phase has been published but this data has not appeared in the literature and thus is presented here in some detail. 10 refs., 4 figs., 6 tabs.

43598 (ENEA-RT-DISP–88-03) **Radioecological survey in a North-Eastern Italian region (Chernobyl accident).** Belli, M.; Blasi, M.; Borgia, A.; Desiato, F.; Poggi, M.; Sansone, U.; Menegon, S.; Nazzi, P. ENEA, Rome (Italy). Direzione Sicurezza Nucleare e Protezione Sanitaria. Sep 1988. 28p. (In Italian). Order Number DE89761961/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

This paper presents the first results of a radioecological survey of the agricultural environment in the North-Eastern region of Italy (Friuli- Venezia Giulia) following the Chernobyl accident. An analysis is made of the selection criteria for 35 sampling stations, selected on the basis of a soils study. Reported are the following: the Cs-137 deposition map of the investigated area; the Cs-137 w-sh-out; the influence of the agricultural practices on the dispersion of radionuclides in soils; the Cs-137 soil-maize transfer factors.

43599 (ENEA-RT-PAS–85-17) **Tritium metabolism in the human body.** Belloni, P.; Breuer, F.; Clemente, G.F.; Di Pietro, S.; Ingrao, G. Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Dipt. Protezione Ambiente e Salute dell'Uomo; ENEA, Rome (Italy). Direzione Sicurezza Nucleare e Protezione Sanitaria. 1985. 12p. Order Number DE89762003/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Current models for dose calculation following tritium intake assume that the tritium metabolism in the human body is the same as that for body water. Consequently, the dose contribution due to a possible presence of an organically bound tritium fraction having a retention time longer than that of aqueous tritium may be heavily underestimated. In order to evaluate a realistic metabolic model in man, tritium was measured, both in the organic bound fraction and in the loose water fraction, in complete daily diets, single food items, urine, blood and various autopsy samples collected from subjects representative of the normal Italian population exposed to the equilibrium conditions characterized by tritium fallout exposure. The results of such measurements showed a significant presence of organically bound tritium, both in foodstuffs and in human tissues. A metabolic model, which takes into account both the water and organic tritium fraction in the body, was developed to fit the experimental data.

43600 (ENEA-RT-PAS–85-20) **Fallout tritium levels in environmental and biological samples in Italy.** Belloni, P.; Clemente, G.F.; Di Pietro, S.; Ingrao, G. Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Dipt. Protezione Ambiente e Salute dell'Uomo. 1985. 6p. Order Number DE89762002/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

This paper describes analytical methods for the determination of low levels of tritium, both in aqueous and organically bound fractions, and of trace elements in human tissue. Organically bound tritium is determined by means of the liquid scintillation technique in which the oxidation water, obtained by the combustion of a small aliquot of the lyophilized sample, is measured. The same technique is used to determine tritium in the loose fraction. The instrumental neutron activation analysis is used for the determination of the trace elements. Preliminary data on a small number of samples are reported.

43601 (ENEA-RT-PAS–88-21) **Whole body counting in Italy (1987) after Chernobyl: Cs-137 and Cs-134 intake.** Melandri, C.; Castellani, C.M.; Tarroni, G.; Formignani, M. Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Oct 1988. 79p. (In Italian). Order Number DE89761992/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Internal contamination data, obtained during 1987 at the ENEA PAS-FIBI-AEROSOL Laboratory in Bologna, after the Chenobyl accident, are presented. The data refer to persons living in the Bologna area, in other Italian regions and to individuals returning from abroad, mainly from Eastern Europe countries. Trends of Cs-137 and Cs-134 internal body burden in adult men resident in Bologna are given together with values of mean daily intake by ingestion and the committed dose equivalents up to december 1987 are evaluated. The measurement campaigns were specifically designed to evaluate male/female activity differences and the distribution of internal contamination levels in various Italian regions.

43602 (FS–88-47-T) **Non-ionizing radiation. Proceedings.** Fachverband fuer Strahlenschutz e.V., Karlsruhe (Germany, F.R.). Nov 1988. 237p. (In German). (CONF-8811249–: 21. annual meeting of Fachverband fuer Strahlenschutz e.V: Non-ionizing radiation (NIR), Koeln (Germany, F.R.), 7-9 Nov 1988). Order Number DE89795711/JAW. Available from NTIS (US Sales Only), PC A11/MF A01.

The technical papers deal with health hazards from radiation, rules for the prevention of accidents, the risk of cancer and radiation effects, as well as the international standardization of UV, light, IR, LASER, static and low-frequency fields, electromagnetic fields, cardiac pacemakers, infrasound, ultrasound, and visual display units. (DG).

43603 (FS–88-47-T, pp. 203-212) **Aspects of radiation effects due to visual display units at work.** Vana, N. (Atominstitut der Oesterreichischen Universitaeten, Vienna). Fachverband fuer Strahlenschutz e.V., Karlsruhe (Germany, F.R.). Nov 1988. (In German). (CONF-8811249–: 21. annual meeting of Fachverband fuer Strahlenschutz e.V: Non-ionizing radiation (NIR), Koeln (Germany, F.R.), 7-9 Nov 1988). In *Non-ionizing radiation. Proceedings.* Order Number DE89795711/JAW. Available from NTIS (US Sales Only), PC A11/MF A01.

The introduction and acceptance of video display units at work have led to a huge flood of information, rumours, and half-truths about those units. As the population became increasingly sensitized to 'radioactive radiation', there was, and in part still is, a tendency to consider particularly effects of unclear origin, first of all ionizing radiation and later on also non-ionizing radiation, as the main threat from video display units at work. Such important issuses as ergonomics, stress load, visual stress load, and social hygiene are often effaced by the question for 'the radiation load from visual display units'. The paper is an attempt to deal with aspects of radiation effects of visual display units at work. The discussion also extends to hazards, respectively the 'radiation environment', at the site of the visual display unit. (orig./DG).

43604 (INIS-mf–11478) **Radiation protection in the application of ionizing radiation in industry.** Mohamad Yusof Mohamad Ali. Unit Tenaga Nuklear, Bangi, Selangor (Malaysia). 1987. 10p. (CONF-8711314–: Seminar on the application of nuclear techniques in industry, 17 Nov 1987). Order Number DE89635218/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI.

There is a substantial increase in the use of ionizing radiation in industry throughout the country especially in the last five years or

so. With this growth in the number of users and activity of sources used, and together with the introduction of the new Atomic Energy Licensing Act (AELA) in 1984, the question of radiation safety and protection of workers and members of the public in general, can no longer be taken lightly. It has to be dealt with effectively. In this paper, a general discussion and clarification on certain practical aspects of radiation protection as recommended by the International Atomic Energy Agency (IAEA) is presented. Amongst the topics chosen are those on area monitoring, personnel monitoring, leak testing of sealed sources and training of personnel. Also presented in the paper is a brief discussion about UTN's experience in giving out radiation protection services to various agencies throughout the country. (author).

43605 (INIS-mf-11503, pp. 14-15) **Estimation of trace elements in organs of mice. Effect of selenite on the toxicity of Cis-DDP.** Schenberg, C. (Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center); Izak-Biran, T.; Mantel, M.; Rachmiel, B.; Weininger, J. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
Transactions.; V. 15.
Summary only.

43606 (ISH–117) **The diaplacental transfer and teratogenicity of tritium in organic compounds.** Kistner, G.; Wiggenhauser, A.; Krestel, R. Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene; Bundesministerium des Innern, Bonn (Germany, F.R.). Oct 1987. 127p. (In German). Contract BMI St.Sch. 716e. Available from Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene.

In the introductory section of this report the relevant literature on the environmental prevalence of tritium, its uptake and distribution in the organisms as well as on the calculation of tritium-related exposure risks is reviewed in brief. The literature study as well as recent workshops on tritium (as e.g. in Karlsruhe, 1986) emphasize the role of organically bound tritium in the assessment of tritium-related radiation exposure. (orig./MG).

43607 (ISH–121) **The influence of radiation treatment on pharmaceuticals and adjuvants. A literature study. Pt. 8. Summary and review of parts 1-7.** Zalewski, C.; Schuettler, C.; Boegl, K.W. Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene. Mar 1988. 437p. (In German). Available from Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene.

The 8th last volume is a summary and review of results from 467 experimental irradiations of 311 substances (based on 134 different sources) discussed in the previous seven volumes. This report is initially introducing a review list of the substances examined in the previous seven volumes. Further data are given on primary literature source. An alphabetical listing of standardized descriptions used in this report is furthermore presented. A list of substances per substance group and a list of substances per reference source are both added. In the results from individual substance groups, a so-called text evaluation is first providing a general review of results from the respective substance group prior to discussing the individual substances. In the summarizing list of each substance group, data are tabulated in reference to irradiation conditions, examining methods and substance decay. The subsequent excerpt from the summarizing list of the respective substance group is compiling the results. All results are compiled in comparison to the decay from irradiation in form of solid substance or aqueous solution; and likewise the effects from a sodiumpyrosulphide additive on the decay of aqueous solutions in comparison to solutions without additives. This is followed by a comparison of decay from radiosterilization and heat sterilization. The report is concluded by a summary of results from investigations on the toxicity of irradiated pharmaceuticals. (orig./MG).

43608 (KFK–4576) **General recommendations for decontamination procedures to individuals.** Ohlenschlaeger, L.; Messerschmidt, J.P. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Medizinische Abt. Apr 1989. 38p. (In German). Order Number DE89911094/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The fundamental criteria in handling radioactive contaminated persons are discussed and methods of monitoring, including monitoring of contaminated wounds, as well as decontamination measures with reference to particularly exposed regions of the body are described. Each decontamination procedure has to be carried out cautiously and has to be stopped as soon as skin lesion would be ensured from too strong mechanical cleansing, in order to avoid any additional incorporation by an injured skin. As a rule, any residual radioactivity still adherent to the skin surface can be neglected as soon as avoidance of spreading of the contamination to surrounding areas is assured. Experience showed that contaminations with radioactive dust can be removed from the skin surface quite easily by such simple means like water and soap. Radioisotopes, however, as used in nuclear medicine, usually are having a higher adhesive effect to the skin surface, thus making conditions for decontamination more difficult. Measures related to the decontamination procedure such as monitoring, mode of sampling for bioassay in case of incidents, handling of waste resulting from decontamination, as well as self-protective aspects are discussed in the annex. (orig.).

43609 (PNL–6500-Pt.4, pp. 30) **Low-energy electron microdosimetry.** Wilson, W.E.; Miller, J.H.; Straume, T. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

For the purpose of evaluating the dosimetry of continuum photon irradiation of oocytes, we have developed a low-energy (secondary) electron transport (Monte Carlo) code by adapting portions of MOCA14. The code allows an isotropic but otherwise arbitrary source spectrum up to 100 keV. Between primary energies of 10 and 100 keV, a straight-ahead approximation is assumed. The simulated oocyte target components are a spherical nucleus of 5 μm diameter concentric with a 6-μm-diameter cell enclosed by a 100-nm-thick membrane. This target is irradiated isotropically by a continuum spectrum calculated (by LLNL) for a 250 kVP x-ray source. For reasons of computer economy the source domain is restricted to less than the maximum range of the most energetic electron. Domains of 20 and 40 μm are being compared for variance from electronic equilibrium. Correlated single-event distributions are obtained for simultaneous energy deposition in the nucleus and in the surrounding cell membrane. Preliminary results indicate that a significant fraction of the single events in the nucleus are accompanied by little or no energy deposition in the membrane.

43610 (PNL–6500-Pt.4, pp. 31-32) **Modeling free radical yields in DNA exposed to high-LET radiation.** Miller, J.H.; Wilson, W.E.; Swenberg, C.E. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

Experiments performed at the Armed Forces Radiobiology Research Institute (AFRRI) with samples of oriented DNA exposed to neutrons suggest that free-radical yields depend upon the orientation of DNA molecules relative to the recoil proton flux. We have developed a model for this effect based on Monte Carlo simulation of the pattern of energy deposition in DNA by protons slowing down in the sample and assuming more rapid migration of energy along DNA chains than between DNA molecules.

43611 (PNL–6500-Pt.4, pp. 37-38) **Irradiation of biological systems by monoenergetic neutrons.** Metting, N.F.; Braby, L.A.; Middendorf, M.E. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

The importance of understanding the relative biological effectiveness (RBE) of neutrons, especially for low dose-rate neutron exposures, has encouraged us to re-evaluate the use of our 2-MV positive ion Van de Graaff accelerator to generate monoenergetic neutrons for use in radiobiological studies. We have obtained dose response curves for both C3H mouse 10T1/2 and mouse L cell

lines as a first step in developing assays of non-lethal end points. A preliminary experiment in which plateau-phase 10T1/2 cells were irradiated with 0.35 Gy of 1.4-MeV neutrons shows a transformation frequency per surviving cell of about 1.2×10^{-4}. This value is slightly lower than the value measured in the same cell line irradiated with JANUS reactor neutrons.

43612 (PNL–6500-Pt.4, pp. 39-41) **Interpreting survival observations using phenomenological models.** Nelson, J.M.; Braby, L.A.; Metting, N.F.; Roesch, W.C. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

The authors have performed experiments to test various competing biophysical models using split-dose, delayed-plating, and low-dose-rate methods. Most ionizing radiation damage appears to be rapairable, but the nature and consequences of the initial unrepaired damage remain uncertain. Saturation models assume only lethal or potentially lethal damage (damage capable of killing the cell unless it is repaired). The accumulation models are based on the assumption that some fraction of the damage is not necessarily lethal or potentially lethal, but sublethal (innocuous damage which can become lethal only after interaction with additional sublethal damage).

43613 (PNL–6500-Pt.4, pp. 42-43) **Modification of damage following low doses.** Braby, L.A.; Nelson, J.M.; Metting, N.F. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

At very low doses the damage-interaction mechanism is responsible for very little lethal or potentially lethal damage, and repair of the latter should essentially disappear. An alternative model suggests that potentially lethal damage is either repaired with a constant half time or misrepaired at a rate which is proportional to the square of the damage concentration. In this case, as the dose decreases, the probability of misrepair decreases faster than the probability of repair, and repair becomes a more pronounced feature of the cell response. Since the consequence of unrepaired damage is an important question in determining the effects of low doses of radiation delivered at low dose rates, we have attempted to determine which of these two types of models is consistent with the response of plateau-phase CHO cells. In the earlier experiments, there was no indication of repair after a 50-rad exposure with a 24-hour split dose or plating delay; in fact, immediate plating resulted in survival slightly above control and delayed plating in survival slightly below the control value.

43614 (PNL–6500-Pt.4, pp. 45-47) **Multiple split-dose repair in plateau-phase mammalian cells.** Nelson, J.M.; Braby, L.A.; Metting, N.F. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

Repair of ionizing radiation damage is observed either as the time-dependent removal of radiation-induced alterations in cellular constituents or as changes in the probability of survival of individual cells. The removal of macromolecular alterations is suggestive of mechanisms leading to changes in cell survival probability and several such processes have been observed in bacteria. However, even though each has its own characteristic repair rate and other distinguishing characteristics, it has proved difficult to demonstrate unambiguous links between these processes and changes in reproductive integrity leading to the observable enhancement of cell survival. Changes in survival probability are observed in split-dose and delayed-plating (or liquid-holding) experiments. These changes are certainly responsible for the shoulder observed in dose-response curves and for what we refer to as the dose-rate effect.

43615 (PNL–6500-Pt.4, pp. 49-50) **Radiation damage repair by subpopulations of stationary-phase CHO cells separated by centrifugal elutriation.** Nelson, J.M.; Metting, N.F.; Braby, L.A. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

The sensitivity of cells to radiation is strongly dependent on the position of the cells within the cell cycle. Since tissues and organs of living animals have characteristic cell division rates which can be perturbed by environmental changes, cell cycle dependence of cellular damage is an essential component of models which are generated in an attempt to correlate the effects in animals with cellular data. Cell cycle variations also provide additional data which may help elucidate the mechanisms controlling cellular damage. Since we have observed two repair rates in plateau phase CHO cells and since these cultures include cells held in various parts of the cycle, it is natural to suspect that the changes in sensitivity may be caused by different parts of the cell cycle. Experiments were performed utilizing centrifugal elutriation methods in order to obtain populations enriched with cells of specific ages.

43616 (PNL–6500-Pt.4, pp. 50-51) **Implementation of additional cell types for transformation studies.** Nelson, J.M.; Metting, N.F.; Braby, L.A. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

Our experience with 10T1/2 cells, the cell line generally used for such experiments, indicates that these cells are not suitable for our studies. We have recently made arrangements to obtain two additional cell lines recently developed by G.W. Barendsen. One of these, the NBCH-3 cell line, was derived from a clone which developed spontaneously in a primary cell culture of tissues from a newborn Chinese hamster. The assay procedure to be used with this cell line is the same as that for the C3H 10T1/2 cells; however, clonal development and morphology are considerably clearer. In addition, another cell line, denoted WAGR-2, was also derived in Barendsen's laboratory from the tissues of a newborn Wistar rat. The origin of the cells is again uncertain, but the procedures used for determining transformation frequencies with this cell line are essentially the same as for C3H 10T1/2 cells. Use of one or both of these new cell systems for our transformation experiments should not only increase the capabilities of the studies, but their use should make the assay both more accurate and simpler to perform.

43617 (PNL–6500-Pt.4, pp. 51-52) **Effect of oxygen on the production of sublethal damage.** Braby, L.A.; Nelson, J.M.; Metting, N.F. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

The response of cells to the concentration of oxygen in their cytoplasm during irradiation has received a great deal of attention. We found, in cells which were hypoxic but which did not show the full expected oxygen enhancement ratio, that the sparing effect of a split-dose interval of a few hours was eliminated, but that effects of longer intervals or a plating delay were not changed. Because this effect depends on the oxygen concentration at the time of irradiation, but is uninfluenced by the concentration during the interval between doses, we believe that it indicates that two different radiation chemistry reactions, one requiring oxygen and the other not, are responsible for the damage that is repaired at the different rates.

43618 (PNL–6500-Pt.4, pp. 55-58) **Deoxycytidine modulates the sensitivity of a repair-deficient CHO cell line to UV light.** Miller, J.H.; Newman, C.H.; Jeggo, P. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

The presence of 2 mM deoxycytidine (CdR) in the growth medium dramatically increases pools of deoxycytidine triphosphate (dCTP) and deoxythymidine triphosphate (dTTP) in a Chinese hamster ovary cell line (CHO-K1) and a radiation-sensitive mutant (xrs-5) derived from it. Since dCMP deaminase activity is high in both cell lines, it is not surprising that CdR increases the size of both dCTP and dTTP pools. In neither medium do we observe a difference between parent and mutant with respect to the size of dCTP or dTTP pools. We have investigated the correlation between

these dNTP pool changes and the effects of 2mM CdR on the response of the cell lines to ultraviolet (UV) light and x-ray exposure. UV mutagenesis of xrs-5 is significantly reduced by the presence of CdR while mutation induction in the parent cell line is unaffected. Similarly, the reduction in cell killing by UV light when the growth medium contains 2 mM CdR is greater for xrs-5 than for the parent cell line. The presence of 2 mM CdR has no effect on the sensitivity of either cell line to killing by x-rays.

43619 (RERF-TR-0-86) **Radiation Effects Research Foundation bibliography of published papers, 1986.** Radiation Effects Research Foundation, Hiroshima (Japan). 1987. 11p. (In Japanese, English). Order Number DE89906610/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The bibliography lists the titles of a total of 75 papers published by members of the Radiation Effects Research Foundation in 1986 (three of them published in 1985). The papers cover; 'The central nervous system and in utero exposure to ionizing radiation', 'Future directions for biostatistics and cancer epidemiology in Japan', 'Passive smoking and lung cancer among Japanese women', 'Late effects of atomic bomb radiation on human immune response', 'Delayed effects of atomic bomb radiation to human cellular immune competence', 'Characterization of three electrophoretic variants of human erythrocyte triosephosphate isomerase found in Japanese', 'A follow-up study of clonal T-lymphocytes with chromosome aberrations in Hiroshima A-bomb survivors', 'Comments on recent cytogenetic findings at RERF', 'Cytogenetic 'rogue' cells; What is their frequency, origin, and evolutionary sinificance?', 'A parallel analysis of cancer mortality among atomic bomb survivors and patients with ankylosing spondylitis given X-ray therapy', 'Cancer of the thyroid and salivary glands', 'Analysis of peripheral blood lymphocytes of atomic bomb survivors using monoclonal antibodies', 'Celluar immune competence of patients with lung cancer and other lung diseases. I. Analysis of peripheral blood lymphocyte subsets using monoclonal antibodies', etc. (N.K.) 75 refs.

43620 (RERF-TR-0-87) **Radiation Effects Research Foundation bibliography of published papers, 1987.** Radiation Effects Research Foundation, Hiroshima (Japan). Aug 1988. 15p. (In Japanese, English). Order Number DE89906572/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report lists the titles and authors of the reports of studies made under the Radiation Effects Research Foundation. The list include 87 studies, which cover 'immunological diagnosis of lung cancer', 'electrophoretic variants of haptoglobin found in the children of atomic bomb survivors', 'rogue cells in the general human population', 'host variation of X-ray sensitivity among atomic bomb survivors with or without breast cancer', 'disorders in the endocrine gland and gonad of A-bomb survivors', 'incidence of vertebral compression fractures among atomic bomb survivors', 'measurement of the frequency of in vivo somatic mutation in atomic bomb survivors by T-cell cloning', 'mechanism of carcinogenesis in A-bomb survivors', 'effects of aging on blood pressure', 'expediting factors of blood sedimentation of heavily exposed survivors', 'record linkage between local cancer registry and tumor and tissue registries', 'reclassification of diagnosis and types of leukemia in atomic bomb survivors in Hiroshima', 'cytogenetic study in utero exposed individuals', 'estimation of indoor and outdoor A-bomb gamma-ray doses by thermoluminescence measurement', and many other studies. (N.K.) 87 refs.

43621 (RERF-TR-3-88) **Effect on intelligence test score of prenatal exposure to ionizing radiation in Hiroshima and Nagasaki. A comparison of the T65DR and DS86 dosimetry systems.** Schull, W.J.; Otake, Masanori; Yoshimaru, Hiroshi. Radiation Effects Research Foundation, Hiroshima (Japan). Oct 1988. 46p. (In Japanese, English). Order Number DE89906462/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Analyses of intelligence test scores (Koga) at 10-11 years of age of individuals exposed prenatally to the atomic bombing of Hiroshima and Nagasaki using estimates of the uterine absorbed dose based on the recently introduced system of dosimetry, the Dosimetry System 1986 (DS86), reveal the following: (1) there is no evidence of a radiation-related effect on intelligence among those individuals exposed within 0-7 weeks after fertilization or in the 26th or subsequent weeks; (2) for individuals exposed at 8-15 weeks after fertilization, and to a lesser extent those exposed at 16-25 weeks, the mean tests scores but not the variances are significantly heterogeneous among exposure categories; (3) the cumulative distribution of test scores suggests a progressive shift downwards in individual scores with increasing exposure; and (4) within the group most sensitive to the occurrence of clinically recognizable severe mental retardation, individuals exposed 8 through 15 weeks after fertilization, the regression of intelligence score on estimated DS86 uterine absorbed dose is more linear than with T65DR fetal dose, the diminution in intelligence score under the linear model is 21-29 points at 1Gy. The effect is somewhat greater when the controls receiving less than 0.01 Gy are excluded, 24-33 points at 1 Gy. These findings are discussed in the light of the earlier analysis of the frequency of occurrence of mental retardation among the prenatally exposed survivors of the A-bombing of Hiroshima and Nagasaki. It is suggested that both are the consequences of the same underlying biological process or processes. (author).

43622 (RERF-TR-5-88) **Life span study report, 11, part 2. Cancer mortality in the years 1950-85 based on the recently revised doses (DS86).** Shimizu, Yukiko; Kato, Hiroo; Schull, W.J. Radiation Effects Research Foundation, Hiroshima (Japan). Dec 1988. 106p. (In Japanese, English). Order Number DE89906463/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

ABCC and its successor, RERF, have followed since 1959 and retrospectively to 1950 the mortality in a fixed cohort of survivors of the atomic bombings of Hiroshima and Nagasaki, the so-called Life Span Study sample. The present study, the 11th in a series that began in 1961, extends the surveillance period three more years and covers the period 1950-85. It is based on the recently revised dose system, called DS86, that has replaced previous estimates of individual exposures. The impact of the change from the old system of dosimetry, the T65DR, to the new on the dose-response relationships for cancer mortality was described in the first of this series of reports. Here, the focus is on cancer mortality among the 76,000 A-bomb survivors within the LSS sample for whom DS86 doses have been estimated, with the emphasis on biological issues associated with radiation carcinogenesis. (author).

43623 (RERF-TR-6-88) **New serum indicator of activity of interstitial pneumonitis. Sialylated carbohydrate antigen KL-6.** Kohno, Nobuoki; Kyoizumi, Seishi; Awaya, Yukikazu; Fukuhara, Hirofumi; Yamakido, Michio; Akiyama, Mitoshi. Radiation Effects Research Foundation, Hiroshima (Japan). Sep 1988. 12p. (In Japanese, English). Order Number DE89906459/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Serum levels of a high molecular weight circulating antigen KL-6, which is detected by sandwich assay using a monoclonal antibody KL-6 against a sialylated carbohydrate antigen, were examined for usefulness in monitoring the activity of interstitial pneumonitis. Of the 59 interstitial pneumonitis patients, 34 (58%) exhibited abnormally high levels of KL-6 antigen in their sera and no significant correlation between serum KL-6 values and lactic dehydrogenase activities was noted. Moreover, KL-6 antigen levels showed a positive correlation with the degree of clinical activity of the disease as measured by ^{67}Ga-citrate scintigram and clinical outcome over time. These data suggest that serum KL-6 antigen may be a new useful indicator for estimating the degree of activity of interstitial pneumonitis, although it cannot be used for differential diagnosis of this disease from other malignant and nonmalignant diseases showing abnormally high levels of KL-6 antigen. (author).

43624 (UCRL-53917) **Estimates of the radiological dose from ingestion of ^{137}Cs and ^{90}Sr to infants, children, and adults in the Marshall Islands.** Robison, W.L.; Phillips, W.A. Lawrence Livermore National Lab., CA (USA). 17 Feb 1989. 29p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89014001/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this report, we examine whether the radiological dose equivalent due to the intake of ^{137}Cs and ^{90}Sr at a contaminated atoll in the Marshall Islands would be greater when intake begins as an adult than when intake begins as an infant or child. We found that

generally ^{137}Cs contributes 97 to 98% of the dose and ^{90}Sr contributes only 2 to 3 %. We also found that the integral 30-, 50-, and 70-y effective dose equivalent estimated for intake beginning as adults is greater than that for intake beginning at any other age. There are two factors that cause the adult estimated dose to be greater than the dose to infants and children. The major factor is the consistently higher intake of local foods, and consequently higher intake of ^{137}Cs, for adults. The second is a combination of changing body weights, fractional deposits, and biological half-life for ^{137}Cs with age, and the reduced concentration of ^{137}Cs in food with time. Consequently, the estimated effective integral dose equivalents for adults due to ingestion of ^{137}Cs and ^{90}Sr can be used as a conservative estimate or intake beginning in infancy and childhood. 95 refs., 4 figs., 10 tabs.

43625 (UCRL–101498) **Mouse model for somatic mutation at the HPRT [hypoxanthine phosphoribosyl-transferase] gene: Molecular and cellular analyses.** Burkhart-Schultz, K.; Strout, C.L.; Jones, I.M. Lawrence Livermore National Lab., CA (USA). 11 Jul 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-8907113–6: 5. international conference on environmental mutagens, 10-15 Jul 1989). Order Number DE89015334/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Our goal is to use the mouse to model the organismal, cellular and molecular factors that affect somatic mutagenesis in vivo. A fundamental tenet of genetic toxicology is that the principles of mutagenesis identified in one system can be used to predict the principles of mutagenesis in another system. The validity of this tenet depends upon the comparability of the systems involved. To begin to achieve an understanding of somatic mutagenesis in vivo, we have been studying mutations that occur in the hypoxanthine phosphoribosyl-transferase (HPRT) gene of lymphocytes of mice. Our in vivo model for somatic mutation allows us to analyse factors that affect somatic mutation. Having chosen the mouse, we are working with cells in which the karyotype is normal, and metabolic and DNA repair capacity are defined by the mouse strain chosen. At the organismal level, we can vary sex, age, the exposure history, and the tissue source of cells analysed. (All studies reported here have, however, used male mice.) At the cellular level, T lymphocytes and their precursors are the targets and reporters of mutation. 26 refs., 1 fig., 1 tab.

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Refer also to citation(s) 41828, 42005, 42358, 43328, 43371, 43401, 43402, 43404, 43468, 43482, 43616

43626 (AD-A–205517/6/XAB) **Modeling the tissue solubilities and metabolic rate constant (V max) of halogenated methanes, ethanes, and ethylenes.** Gargas, M.L.; Seybold, P.G.; Andersen, M.E. Air Force Aerospace Medical Research Lab., Wright-Patterson AFB, OH (USA). 1988. 23p. (AAMRL-TR–88-065). Available from NTIS, PC A03/MF A01.

Pub. in Toxicology Letters, Vol. 43, 235-256(1988).

Experimental solvent:air and tissue:air partition coefficients for 25 halogenated methanes, ethanes, and ethylenes in saline solution; olive oil; and rat blood, muscle, liver, and fat tissues were examined using theoretical molecular modeling techniques. The metabolic rate constant, V_{max}, was also investigated by these techniques for 19 chlorinated compounds in this group. Two graph theoretical approaches (the distance method of Wiener and the connectivity index method of Randic, Kier, and Hall) and an approach utilizing ad hoc molecular descriptors were employed. Satisfactory regression models for solubility were obtained with both the Randic-Kier-Hall approach and the ad hoc descriptors approach. Fluorine substituents decrease tissue solubilities, whereas both chlorine and bromine substituents increase tissue solubilities, with the relative influence being chlorine<bromine. Tissue solubilities can also be represented conveniently in terms of contributions from oil and saline solubilities, a procedure reinforced by factor analysis of the data. Equations derived by these methods adequately estimated the solubilities for eight additional compounds. No approach could successfully model V_{max} for all 19 compounds, but a subset of 16 compounds was modeled using the connectivity indices. The equation is limited in its use but indicated future modeling directions for V_{max}.

43627 (AD-A–206082/0/XAB) **Dealing with uncertainty in chemical risk analysis. Master's thesis.** Clement, D.S. Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering. Dec 1988. 176p. (AFIT/GOR/MA–88D-2). Available from NTIS, PC A09/MF A01.

For a given chemical there are usually several methods for estimating the risk. Each method is based on different assumptions. The arguments are plentiful for each method, but which method best estimates the risk. Choosing one method over another could lead to faulty risk estimates, thus the traditional methods have been very conservative to avoid underestimating the risk. With advances made in pharmacokinetics the EPA has come under pressure to re-evaluate its procedure for assigning risk. Which method or methods should be used and how much emphasis should be placed on each one. This study decomposes the various methods into their corresponding assumptions. A tree diagram is generated to describe the combinations of assumptions that make up each unit risk method. A subjective weight is assigned to each assumption (branch of the tree) to characterize its validity in estimating the risk. From this a weighted average of risk is calculated. A procedure is recommended for combining expert opinion when several experts are utilized in assigning the subjective weights. Two examples involving Methylene Chloride and 2,3,7,8-tetrachlorodibenzo-p-dioxin illustrate the decomposition method of estimating chemical risk.

43628 (AD-A–206743/7/XAB) **Synthesis of the results of the field-verification program wetland disposal alternative. Final report.** Simmers, J.W.; Rhett, R.G.; Kay, S.H.; Folson, B.L. Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab. Feb 1989. 53p. (WES/TR/D–89-2). Available from NTIS, PC A04/MF A01.

Contaminated dredged material from the Black Rock Harbor (BRH) maintenance dredging project of the US Army Engineer Division, New England, was used to field verify: (a) procedures for predicting contaminant mobility into plants and (b) procedures for predicting contaminant mobility into animals. The wetland disposal site was constructed within a protected area using conventional construction techniques and was hydraulically filled from barges. The estuarine plant-bioassay procedures was used in the laboratory to evaluate heavy-metal uptake by plants from composited BRH sediment. The chemical and laboratory portions of the bioassay were used to predict potential plant uptake of heavy metals. In general, the laboratory plant-bioassay adequately predicted heavy metal content of field-grown Spartina alterniflora during the first 2 years following establishment of the wetland. The wetland animal-bioassay procedures was applied to composited BRH sediment in the laboratory using an adaptation of the plant bioassay apparatus. This adaptation was unsuitable because of high sandworm mortality during the test. Another study conducted with fresh sediment indicated that the BRH sediment had to be diluted for the animals to survive the static conditions of the test. A preliminary dynamic, tidal simulation rather than static bioassay was conducted using undiluted BRH sediment. The wetland animals not only survived in the simulated tidal bioassay, but results indicated that there was a potential for accumulation of heavy metals and organic contaminants.

43629 (AD-A–206976/3/XAB) **Preliminary pollutant limit value approach: manual for users. Final report, January 1987-June 1988.** Small, M.J. Army Biomedical Research and Development Lab., Fort Detrick, MD (USA). 1 Jul 1988. 130p. (USABRDL-TR–8918). Available from NTIS, PC A07/MF A01.

The Preliminary Pollutant Limit Value (PPLV) Approach to developing guidance contamination levels in soil and water is an established procedure throughout the US Army. In 1984, Technical Rept 8210 was issued to provide users with a reference document as to pathway equations and efforts in the development of the Rocky Mountain Arsenal Endangerment Assessments. In the approach, unique routes for human exposure to pollutants from a common medium (soil or water) are defined. Equations are presented for 7 such routes for water and 13 such routes for soil. These routes include water consumption, fish consumption, vegetable consumption, consumption of beef or dairy, direct intake of

soil, either in ordinary activities or from a dusty work site, and inhalation of volatile contaminants from a land site. In the case of beef and dairy consumption, consideration is given to animal exposure to a contaminant which is in feed material, drinking water or soil consumed when the animals graze.

43630 (DGMK–174-4) **Effects of ethylene on man and animals.** Angerer, J.; Herrmann, H.; Jungen, H.; Taeuber, U.; Wenzel-Hartung, R.P. Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.). Nov 1988. 103p. (In German). Available from Copy held by UB/TIB Hannover.

The available scientific and practical knowledge concerning the effects of ethylene on humans and animals is reviewed and evaluated. The report describes the properties, preparation and industrial applications of ethylene, its natural occurence, uptake and transformation, and the distribution, excretion and detection of ethylene and its metabolites in humans and animals. The report is based on an extensive study of relevant publications and contains a detailed bibliography. According to the DGMK, observations so far suggest only a low toxic potential of chronic exposure to ethylene. On the other hand, a small fraction of ethylene is converted in the human organism into the carcinogenic metabolite ethylene oxide, so that a potential carcinogenic effect, however slight, cannot be excluded even if it may never been proved. (orig./MG) With 1 fig., 9 tabs.

43631 (DOE/EV/04580–8) **Mechanisms and functional morphology associated with metal transport in Mercenaria mercenaria (Bavalvia: Mollusca): Final report, September 1, 1977–February 28, 1989.** Robinson, W.E.; Morse, M.P. New England Aquarium Corp., Boston, MA (USA). Harold E. Edgerton Research Lab. 28 Feb 1989. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-77EV04580. Order Number DE89015789/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

From September 1977 through July 1981 the primary goal of our research was to determine the effect of oil-well drilling muds on the commercially important bivalve species of Georges Bank. Studies included toxicological effects of various drilling mud components, research on energy stores and reproduction, effects of turbidity on feeding and digestion in both adult and larval bivalves, and the effects of drilling mud components on bivalve gills. Our findings implicated a variety of metals present in drilling muds as the purveyors of both lethal and sublethal effects, and prompted our subsequent work on the mechanisms of metal accumulation, detoxification and transport in marine bivalve molluscs (August 1981 through February 1989). Using radioactive cadmium (primarily) and silver, we have examined metal-storage compartments and kidney detoxification mechanisms in Mercenaria mercenaria. Results have shown that the kidney is the primary site of metal sequestration, due to both a low molecular weight metal-binding protein and numerous calcium phosphate granules. Metal transport experiments have shown that blood plasma proteins may play a major role in transporting metals to the kidney for sequestration and elimination. 31 refs.

43632 (EC–ARB-169-86) **Nanticoke spring grain study, 1985.** Pearson, R.G.; Archibald, B.; Bentley, H. Environment Canada, Ottawa, ON (Canada). 1987. 57p. (MICROLOG–87-06370). Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In 1985, following numerous complaints from farmers in the vicinity of the Nanticoke industrial complex (which contains a large thermal power plant) that they could no longer grow spring cereal crops due to adverse air quality conditions, a field study was initiated. It consisted of establishing a total of 15 spring barley study sites throughout the area to the north and northeast of the complex, and in a control area located well remote from the area of concern but with similar soil and meteorological conditions. During the growing season, the sites were observed an sampled extensively for foliar chemistry, nutrient status, soil accumulation and fertility parameters. The physical condition of the various soils and barley crops also was recorded and all sites were harvested for yield determination. In all, over 3000 chemical and physical test parameters were generated for evaluation. In addition to the crop monitoring in 1985, historical barley yields from this area were obtained and compared with rainfall data and with SO_2 air quality monitoring results during the past 11 years. These seasonal air quality parameters were then compared with the dose-response relationships that were obtained from a literature review. Results showed no relationship between historical air quality (sulfur dioxide) patterns and crop productivity. The 1985 results also ruled out any significant elemental deposition or foliar contamination which would be detrimental to the growth of spring grains in this area. The findings did reveal, however, that the heavy clay soils in this area are prone to severe hard-pan formation and to adverse weather (rainfall) conditions. In this regard, spring planting date appears to be the single greatest factor affecting crop yield. 13 refs 5 figs 22 tabs

43633 (EPRI-EA–6072, pp. 7.1-7.27) **Statistical analysis of Salmonella test data and comparison to results of animal cancer tests.** McCann, J. (Lawrence Berkeley Lab., CA (USA)); Horn, L.; Kaldor, J.; Gold, L.S.; Siegel, R.; McGill, R.; Graedel, T.E. Electric Power Research Inst., Palo Alto, CA (USA); Clement Associates, Inc., Ruston, LA (USA). Nov 1988. (CONF-8603254–: EPRI workshop on innovative approaches in cancer risk assessment, Mar 1986). In *Innovative approaches in cancer risk assessment. Proceedings.* Order Number DE89004099/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The results are described of several collaborative studies aimed at examining the utility of short-term tests in the carcinogenic risk assessment process focusing on the Salmonella (Ames) test. Here, most recent work is presented, including new techniques for the display and analysis of Salmonella data and comparisons of Salmonella results with animal cancer test results. The research has had two basic purposes. First, the use of short-term tests is validated by comparing results to those obtained from animal tests that measure carcinogenesis directly. Relevant to this is the recent work done to extend the positivity comparisons performed with Bruce Ames some years ago and to compare measures of mutagenic and carcinogenic potency. Second, short-term tests are examined as a self-contained unit, without reference to how results might or might not compare to other systems considered more relevant to humans. Since short-term tests measure different aspects of DNA- damaging potential, it is useful to classify chemicals according to this potential and thereby further our understanding of their potential to interact with living systems in harmful ways. Work begun in this area will also briefly be discussed.

43634 (FEARO–802) **Canadian Environmental Protection Act. Priority substances list.** Federal Environmental Assessment Review Office, Ottawa, ON (Canada). 1989. 543-545p. (In English and French). (CE–02655). Available from Federal Environmental Assessment Review Office, Fontaine Bldg., 13th floor, Ottawa, ON, CAN K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

According to the Canadian Environmental Protection Act, proclaimed June 30, 1988, the Ministers shall compile and may amend from time to time a list known as the Priority Substances List, and the List shall specify substances in respect of which the Ministers are satisfied priority should be given in assessing whether they are toxic or ccapable of becoming toxic. this list is given here. Assessment reports for the substances in groups 1, 2, and 3 are planned for completion within 3, 4, and 5 years, respectively. 1 tab.

43635 (ORNL/M–878) **TNT metabolites in animal tissues: Quarterly technical progress report (No. 3), April 1, 1989–June 30, 1989.** Shugart, L.R. Oak Ridge National Lab., TN (USA). Jul 1989. 27p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. Order Number DE89015413/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The overall objectives of this project are: (1) to provide quantitative analytical procedures for the analysis of TNT and at least eight of its metabolites in animal tissues, and (2) to obtain representative samples of tissues from animals from designated Army sites and to determine the presence or absence of TNT and its metabolites in these samples. The study is divided into two Phases corresponding to the stated overall objectives of the project.

43636 (ORNL/M–889) **Disposal of chemical agents and munitions stored at Anniston Army Depot, Anniston, Alabama: Final Phase 1 environmental report.** Oak Ridge National Lab., TN (USA). Jul 1989. 157p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC05-84OR21400. Order Number DE89016276/JAW. Available from NTIS, PC A08/MF A01 - OSTI.

The purpose of this Phase I report is to examine the proposed implementation of on-site disposal at Anniston Army Depot (ANAD) in light of more detailed and more recent data than those included in the Final Programmatic Environmental Impact Statement (FPEIS). Two principal issues are addressed: (1) whether or not the new data would result in identification of on-site disposal at ANAD as the environmentally preferred alternative (using the same selection method and data analysis tools as in the FPEIS), and (2) whether or not the new data indicate the presence of significant environmental resources that could be affected by on-site disposal at ANAD. In addition, status reports are presented on maturity of the disposal technology (and how it could affect on-site disposal at ANAD) and on the tracking of changes in technology to ensure that the overall risk identified in the FPEIS is not exceeded. 6 refs., 11 figs., 10 tabs.

43637 (PB–89-168272/XAB) **Value of LD 50 as given for the acute toxicity of products and compounds). Final report.** Gezondheidsraad, The Hague (Netherlands). 24 Jun 1988. 78p. (In Dutch). Available from NTIS, PC EE05/MF A01.

Presented is a South African study of alternatives to using laboratory animals for toxicity testing. Results suggest that a reduction of 35-100% in animal usage is possible when drugs and cosmetics are tested by other than the traditional methods.

43638 (PB–89-174726/XAB) **Emergency and continuous exposure guidance levels for selected airborne contaminants: Volume 8. Lithium chromate and trichloroethylene. Final report.** National Research Council, Washington, DC (USA). Committee on Toxicology. Mar 1989. 73p. Available from NTIS, PC A04/MF A01.

See also PB–86-145158.

This report recommends emergency exposure guidance levels (EEGLs) of 1 and 24 hours for lithium chromate and trichloroethylene. The EEGL for lithium chromate is 100 micrograms/cu m for 1 hour and 50 micrograms/cu m for 24 hours. The EEGL for trichloroethylene is 200 ppm for 1 hour and 10 ppm for 24 hours. A survey of the relevant literature and a rationale for the recommendations promulgated is included.

43639 (PB–89-178529/XAB) **Toxicology and carcinogenesis studies of crocidolite asbestos (CAS No. 12001-28-4) in F344/N rats (feed studies). Technical report.** National Toxicology Program, Research Triangle Park, NC (USA). Dec 1988. 177p. (NTP-TR–280). Available from NTIS, PC A09/MF A01.

Toxicology and carcinogenesis studies of crocidolite asbestos were conducted by administering the chemical to male and female F344/N rats at a concentration of 1% in feed for the lifetime of the animals. Under the conditions of these feed studies, crocidolite asbestos was not overtly toxic and did not cause a carcinogenic response when ingested at a concentration of 1% in the diet by male and female F344/N rats for their lifetime.

43640 (PB–89-178891/XAB) **Effects of ozone on cellular synthesis and viral replication in vitro. Final report, January 1985-November 1988.** Zee, Y.C. California Univ., Davis, CA (USA). Dept. of Veterinary Microbiology and Immunology. Nov 1988. 85p. Available from NTIS, PC A05/MF A01.

This project used a system developed for exposing isolated cells and tissues to ozone to address three major objectives: to determine the effect of ozone on the replication of several human and animal viruses; to investigate the effects of ozone on rates of macromolecular synthesis in several cell lines; and to measure the effects of ozone on the ability of tracheal tissue to produce interferon. The major result was that cells infected with viruses either during or after ozone exposure were capable of supporting normal viral replication. A separate result showed that cellular damage generally increased with increased ozone exposures and that longer exposure times appeared to cause cellular changes that were not apparent after shorter exposure times. Additionally, ozone exposures had no effect on the ability of isolated tracheas to produce interferon.

43641 (PB–89-181366/XAB) **Evaluation of the potential carcinogenicity of lead and lead compounds: in support of reportable quantity adjustments pursuant to CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) section 102. Draft report.** Environmental Protection Agency, Washington, DC (USA). Office of Health and Environmental Assessment. Mar 1989. 142p. (EPA–600/8-89/045A). Available from NTIS, PC A07/MF A01.

Information on the potential carcinogenicity of lead and lead compounds is summarized and evaluated. The human studies provide suggestive evidence of carcinogenicity, but, because of confounding exposures to other carcinogens and the lack of measurements of lead exposure, are inadequate to prove or disprove carcinogenicity. Numerous long-term animal studies, using several different forms of lead and routes of exposure, provide sufficient evidence. This combination of evidence, together with information from short-term tests, other toxic effects, and pharmacokinetic properties, yields a classification of lead and lead compounds as probably human carcinogen, Group B2. No specific cancer potency has been estimated for lead. Many factors influence lead-induced cancer, creating difficulties in selecting an appropriate measure of dose. Cross-species pharmacokinetic models are needed before the animal studies can be used to estimate a human cancer potency. Because it has been relatively high concentrations of lead that have increased the incidence of cancer in animals, it seems appropriate to characterize the cancer potency of lead as low, placing lead in potency Group 3.

43642 (PB–89-181986/XAB) **Health-hazard evaluation determination report No. 77-10-412; American Smelting and Refining Company, Denver, Colorado.** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Aug 1977. 25p. (HHE–77-010-412). Available from NTIS, PC A03/MF A01.

Environmental and medical surveys were conducted on December 6-9, 1976 and March 28-30, 1977 to evaluate potential hazards associated with exposure to cadmium, lead, and zinc during the operation of a secondary smelter at the Globe facility of the American Smelting and Refining Company in Denver, Colorado. Blood lead concentrations exceeded the harmful concentration of 60 micrograms per 100 ml. Elevated blood-lead concentrations corresponded with an elevated free erythrocytic protoporphyrin concentration. Blood-cadmium concentrations exceeded the nonexposed concentration of 1 microgram per 100 ml. Urine-cadmium concentrations exceeded the 15 micrograms per gram creatinine normal concentration. Environmental-cadmium concentrations exceeded the OSHA standard of 0.1 mg/Cum. All zinc concentrations were below recommended standards. Environmental-lead concentrations exceeded the OSHA standard of 0.2 mg/CuM. The authors conclude that a health hazard to workers exposed to lead and cadmium did exist at the time of the evaluation.

43643 (PB–89-183065/XAB) **Effects of temperature and particle size on acid aerosol-induced bronchoconstriction. Report for April 1986-November 1988 (Final).** Sheppard, D.; Balmes, J.; Christian, D. California Univ., San Francisco, CA (USA). Cardiovascular Research Inst. Jan 1989. 59p. Available from NTIS, PC A04/MF A01.

The investigators exposed asthmatic subjects to aerosols of sulfuric acid or saline with varying particle size and osmolarity. Aerosols of unbuffered sulfuric acid at pH 2 did not cause bronchoconstriction in the subjects when inhaled during rest at a sulfate concentration of nearly 3 mg/cm m. Neither osmolarity nor particle size appeared to influence the lack of bronchoconstrictor effect. The investigators also studied whether there was a positive interaction between acidity and low temperature with regard to the potentiation of hypoosmolar aerosol-induced bronchoconstriction. They exposed asthmatic subjects to hypoosmolar aerosols of either sulfuric acid at pH 2 or saline at pH 5.5 at either 7 or 22 deg C. No evidence of a positive interaction between acidity and low temperature was found.

43644 (PB–89-184519/XAB) **Study to determine the possible hazard of methylmercury in seafood to the fetus in utero. Final report, 1980-1985.** Marsh, D.O.; Turner, M.D.; Smith, J.C. National Fisheries Inst., Inc., Washington, DC (USA). Dec 1985. 96p. Available from NTIS, PC A05/MF A01.

This study was conducted to determine the possible hazards of methylmercury (MeHg) in seafood to the fetus in utero. Hair and

blood samples of pregnant women in New Bedford, MA, Manta, Ecuador, and Mancora, Peru (all areas of high seafood consumption) were examined. These samples were collected and studied at various stages of gestation and during pre- and post-natal periods. In some cases, blood and hair samples of some of the infants born to these women were also examined. The women of Manta and Mancora showed higher levels of MeHg than the women in New Bedford. However, no health hazards could be linked to any of the infants from the ingestion of MeHg in marine fish. Although no human data exist, experimental evidence suggests marine fish may contain elements that reduce the toxicity of MeHg and it's possible that selenium contributes to the protective effect of fish vs. grain diets. Tables of MeHg levels in the study groups are attached to the report.

43645 (PB–89-185706/XAB) **Toxicological Profile for Arsenic. Final report.** Life Systems, Inc., Cleveland, OH (USA). Mar 1989. 131p. Available from NTIS, PC A07/MF A01.

The ATSDR Toxicological Profile for Arsenic is intended to characterize succinctly the toxicological and health-effects information for the substance. It identifies and reviews the key literature that describes the substance's toxicological properties. Other literature is presented but described in less detail. The profile is not intended to be an exhaustive document; however, more comprehensive sources of specialty information are referenced. The profile begins with a public health statement, which describes in nontechnical language the substance's relevant toxicological properties. Following the statement is material that presents levels of significant human exposure and, where known, significant health effects. The focus of the document is on health and toxicological information.

43646 (PB–89-187173/XAB) **Pentachlorophenol hazards to fish, wildlife, and invertebrates: a synoptic review. Biological report.** Eisler, R. Patuxent Wildlife Research Center, Laurel, MD (USA). Apr 1989. 83p. (BIOLOGICAL–85(1.17)). Available from NTIS, PC A05/MF A01.

Pentachlorophenol (PCP) is now widely used as a wood preservative; this use has contributed to the presence and detection of PCP residues in air, rain, ground water, surface water, fish and aquatic invertebrates, and human urine, blood, and milk. The report reviews the technical literature on ecological and toxicological aspects of PCP in the environment, with emphasis on fishery and wildlife resources. Subtopics include sources and uses, chemical properties, fate, background concentrations, lethal and sublethal effects, and current recommendations for resource protection.

43647 (PB–89-190102/XAB) **Investigations in fish control: 98. History of acute toxicity tests with fish, 1863-1987.** Hunn, J.B. National Fishery Research Lab., La Crosse, WI (USA). 1989. 16p. (LCCCN–89-600014). Available from NTIS, PC A03/MF A01.

See also PB–89-154108. Library of Congress catalog card no. 89-600014.

Acute-toxicity tests with fish were first reported in 1863. Test methodology developed slowly before World War II but after the war, considerable effort was made to standardize test methods. A standardized method was published in 1960, refined in 1975, and updated in 1980. The primary use of the static acute-toxicity test is to determine the median concentrations of chemicals that are lethal to aquatic organisms. Static acute-toxicity tests will continue to play an essential role in aquatic toxicology in the foreseeable future.

43648 (PB–89-190383/XAB) **Health assessment of toluene in California drinking water.** Reed, N.; Reed, W.; Beltran, L.; Li, R.; Encomienda, I. California Univ., Davis, CA (USA). Dept. of Environmental Toxicology. 8 Mar 1989. 145p. (UCD/ET–89/1). Available from NTIS, PC A07/MF A01.

This report reviews existing literature pertinent to the health risk posed by the use of toluene-contaminated drinking water. Also included in the study is an estimate of the toluene exposure of California residents based on the most recent data on toluene concentrations in California drinking water supplies. The concentration of toluene in drinking water that may cause adverse health effects is delineated.

43649 (PB–89-862049/XAB) **Bioaccumulation of heavy metals by fish. January 1977-May 1989 (Citations from the Selected Water Resources Abstracts data base). Report for January 1977-May 1989.** National Technical Information Service, Springfield, VA (USA). May 1989. 131p. Available from NTISPC N01/MF N01.

Supersedes PB–87-866810.

This bibliography contains citations concerning distribution and bioaccumulation of heavy metals in marine and freshwater fish. Surveys, toxicological effects, mechanisms of accumulation, as well as temperature and concentration effects are discussed. (This updated bibliography contains 220 citations, 26 of which are new entries to the previous edition.)

43650 (PB–89-863617/XAB) **Toxicity of fibers and fiber composites. January 1970-September 1988 (Citations from the NTIS data base). Report for January 1970-September 1988.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 276p. Available from NTISPC N01/MF N01.

See also PB–89-863625.

This bibliography contains citations concerning the toxicity of occupational exposures to fibers and fiber composites. Topics include respiratory illnesses due to chronic exposure to asbestos and glass fibers, and methods and equipment for control of airborne fibers. (This updated bibliography contains 433 citations, none of which are new entries to the previous edition.)

43651 (PB–89-863625/XAB) **Toxicity of fibers and fiber composites. October 1988-May 1989 (Citations from the NTIS data base). Report for October 1988-May 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 41p. Available from NTISPC N01/MF N01.

Supersedes PB–88-869722. See also PB–89-863617.

This bibliography contains citations concerning the toxicity of occupational exposures to fibers and fiber composites. Topics include respiratory illnesses due to chronic exposure to asbestos and glass fibers, and methods and equipment for control of airborne fibers. (This updated bibliography contains 48 citations, all of which are new entries to the previous edition.)

43652 (PB–89-864102/XAB) **Toxicity bioassays: water-pollution effects on aquatic animals and plants. June 1986-June 1989 (Citations from the Selected Water Resources Abstracts data base). Report for June 1986-June 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 66p. Available from NTISPC N01/MF N01.

Supersedes PB–88-863907.

This bibliography contains citations concerning toxicity bioassay studies of water-pollution effects on reproduction, growth, and mortality of aquatic animals and plants. Industrial and agricultural water pollutants such as metals, chemicals, pesticides, and herbicides are evaluated and tested. Standard fishes and algal assays are used to determine effects of potential toxicants. (This updated bibliography contains 94 citations, 32 of which are new entries to the previous edition.)

43653 (PB–89-864755/XAB) **Toxicity of halogenated organic compounds. March 1983-June 1988 (Citations from the NTIS data base). Report for March 1983-June 1988.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 253p. Available from NTISPC N01/MF N01.

See also PB–89-864763.

This bibliography contains citations concerning health and environmental effects of halogenated organic compounds. Topics include laboratory and field investigations regarding bioaccumulation and concentration, metabolic aspects, and specific site studies in industrial and commercial operations. Pesticides, solvents, and a variety of industrial compounds are discussed. (This updated bibliography contains 398 citations, none of which are new entries to the previous edition.)

43654 (PB–89-864763/XAB) **Toxicity of halogenated organic compounds. July 1988-June 1989 (Citations from the NTIS data base). Report for July 1988-June 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 68p. Available from NTISPC N01/MF N01.

Supersedes PB–88-866330. See also PB–89-864755.

This bibliography contains citations concerning health and environmental effects of halogenated organic compounds. Topics include laboratory and field investigations regarding bioaccumulation and concentration, metabolic aspects, and specific site studies in industrial and commercial operations. Pesticides, solvents, and a variety of industrial compounds are discussed. (This updated bibliography contains 93 citations, all of which are new entries to the previous edition.)

43655 (PNL–6500-Pt.4, pp. 1-4) **Determination of adducts of polycyclic aromatic hydrocarbons to DNA.** Bean, R.M.; Chess, E.K.; Thomas, B.L.; Dankovic, D.A.; Pavlovich, J.; Mann, D.B.; Franz, J.A.; Springer, D.L. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

The objective of this work is to develop methods for the analysis of DNA adducts that will permit identification and quantification of adducted polycyclic aromatic hydrocarbon metabolites at environmental levels. The primary analytical approach is to isolate the bound metabolites by cleaving the covalent bond that attach them to the DNA, and to treat them with reagents that will increase their sensitivity to mass spectrometric detection.

43656 (UCRL–21110) **Conventional weapons demilitarization: A health and environmental effects data base assessment: Propellants and their co-contaminants.** Mallon, B.; Layton, D.; Fish, R.; Hsieh, P.; Hall, L.; Perry, L.; Snyder, G. Lawrence Livermore National Lab., CA (USA). Aug 1988. 193p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. Order Number DE89016664/JAW. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

The demilitarization of propellants by open burning results in the deposition of residues on soils. Residues can consist of the main ingredients in propellant formulations, namely, nitrocellulose, nitroglycerin, and nitroguanidine. Co-contaminants, consisting of plasticizers and stabilizers present in propellant formulations as well as environmental degradation products of the propellants, represent additional soil contaminants. These substances include nitrosoguanidine, dibutylphthlate, diethylphthlate, dipenylamine, and ethyl centralite. To support studies of the health and environmental risks of such by-products, this report presents assessments of data available on parameters that affect the risks posed by propellants and their principal co-contaminants. Specifically, data-base assessments cover factors that influence the transport and fate of the contaminants in environmental media (e.g., soils, water, etc.) and subsequently, human exposures via different pathways (e.g., inhalation, ingestion, and skin absorption). Importantly, information on dose-response relationships for various toxic effects in humans and laboratory animals is evaluated so that acceptable daily intakes for noncarcinogenic substances and virtually safe dose rates species are also addressed. 284 refs.

5604 Other Environmental Pollutant Effects

Refer also to citation(s) 42322

43657 (AD-A–206152/1/XAB) **Intensity threshold for 60-Hz magnetically induced behavioral changes in rats.** Liboff, A.R.; Thomas, J.R.; Schrot, J. Naval Medical Research Inst., Bethesda, MD (USA). 1989. 4p. (NMRI–89-14). Available from NTIS, PC A02/MF A01.

Pub. in Bioelectromagnetics, Vol. 10, 111-113(1989).

Experiments were conducted to further investigate the effect of 60-Hz cyclotron-resonance exposures on rats performing on a multiple FR-DRL schedule. The previously reported temporary loss of DRL baseline response, when measured as a function of A.C. magnetic intensity, was found to have a threshold. Utilizing the component of A.C. magnetic intensity parallel to the D.C. field, we report this threshold as (0.27 + or - 0.10) X 10-4 Trms.

43658 (AD-A–206230/5/XAB) **Functional assessment of laser irradiation. Final report (Annual), 1 July 1974-30 June 1986.** Robbins, D.O. Ohio Wesleyan Univ., Delaware, OH (USA). Dept. of Psychology. Mar 1988. 30p. Available from NTIS, PC A03/MF A01.

Exposure of the fovea to intense coherent light can produce either transient or permanent changes in the eye's ability to resolve fine spatial detail. Permanent functional changes can occur in the absence of gross morphological damage and at power densities below the ED50 level. Furthermore, the eye may become increasingly susceptible to damage after repeated low-level exposures which initially produce only transient effects. Independent of any long-term hazards, laser exposures can also disrupt visual/motor behavior for periods of up to 96 hrs.

43659 (AD-A–206290/9/XAB) **Noise and sonic-boom impact technology. PCBOOM computer program for sonic-boom research. Volume 1. Technical report. Final report, May 1987-October 1988.** Bishop, D.E. BBN Labs., Inc., Canoga Park, CA (USA). Oct 1988. 56p. (BBN–6741-VOL-1). Available from NTIS, PC A04/MF A01.

See also Volume 2, AD-A206 291.

The PCBOOM computer program, described in this technical report, calculates the location and magnitude of sonic-boom overpressures on the ground due to supersonic flight under standard atmosphere and no wind-propagation conditions. The program is intended for environmental planners and engineers who may need to estimate the noise impact from individual flights of supersonic military aircraft. The program runs on a Zenith Z-248 personal computer and also should run on most similarly configured IBM-compatible computers. The program contains information for all current military aircraft and allows updating for additional aircraft. The user can select either 'Quick look' computations which assume steady-state flight or detailed ray-tracing calculations which can handle nonsteady flight and sonic-boom focus conditions. Several types of simple maneuvers can be selected for computations; the program will also handle up to ten connected straight-line segments. Flight segments from the MOAOPS library of supersonic combat training flights may also be selected. User-specified output for printer, plotter or screen includes tables of overpressures and graphic display of the sonic-boom overpressure 'footprints' on the ground. The footprint plots show the location of all ray positions that exceed overpressures of a given level. Flight track, Mach number, and altitude profile plots are also provided. This report summarizes the technical basis for PCBOOM. Two other reports provide a program users/computer operations manual and a program maintenance manual.

43660 (AD-A–206291/7/XAB) **Noise and sonic-boom impact technology. PCBOOM computer program for sonic-boom research. Volume 2. Program users/computer operations manual. Final report, May 1987-October 1988.** Salvetti, A.; Seidman, H. BBN Labs., Inc., Canoga Park, CA (USA). Oct 1988. 58p. (BBN–6742-VOL-2). Available from NTIS, PC A04/MF A01.

See also Volume 1, AD-A206 290.

This report contains the information for both the user and for computer operations. The report provides the user with the information necessary to effectively use PCBOOM. In addition, it provides the computer operations personnel with a description of the computer system and its associated environment. Two other reports provide a technical discussion of the algorithms used and a program maintenance manual.

43661 (AD-A–206514/2/XAB) **Additivity of retinal damage for multiple-pulse laser exposures. Final report, October 1985-January 1988.** Zuclich, J.A.; Blankenstein, M.F. Krug International, San Antonio, TX (USA). Technology Services Div. Dec 1988. 25p. Available from NTIS, PC A03/MF A01.

This study examined the cumulative effects of multiple-pulse laser exposures in contributing to retinal damage via a thermal mechanism. Three sets of experiments have been conducted to determine the variation of multiple-pulse thresholds: With the interval between pulses; with the number of pulses in the pulse train when the interpulse interval is held constant; and with the retinal image size when both number of pulses and interpulse interval are invariant. In addition, thermal model calculations were carried out to compare model predictions with the experimental data. Conclusions from the experimental data are: (1) The threshold for a multiple-pulse train is related to that for an individual pulse in the train by a function of the number of pulses, but is independent of pulse-repetition frequency and pulse train length. This observation is in general accordance

both with the thermal model predictions and with previously empirical models. (2) The additivity of multiple pulses is quantitatively similar for collimated and expanded laser beams incident at the eye. (3) The repair or recovery of laser-induced reversible retinal damage (i.e., sub-threshold with respect to the ophthalmoscopic lesion endpoint) is slow, having a time constant of the order of days. Thus, the cumulative nature of multiple-pulse or repeated exposures within a 24-hr period is relatively unaffected by the ongoing repair process; and only when repeated daily exposures are of concern does the repair process become a factor.

43662 (AD-A–206923/5/XAB) **Theoretical models for interaction of electromagnetic fields with biological tissues. Final report, 1 July 1986-1 July 1988.** Nussbaum, J.H.; Grodzinsky, A.J. Massachusetts Inst. of Tech., Cambridge, MA (USA). Lab. for Electromagnetic and Electronic Systems. Jan 1989. 28p. Available from NTIS, PC A03/MF A01.

This work demonstrates that electric fields can modulate intramembrane ionic concentrations, transmembrane ionic fluxes, mechanical conformation of membranes, and transmembrane potential. Even symmetrically applied fields of opposite polarities can result in asymmetric mechanical, concentration and flux responses, hence rectification of electrochemical and electrochemical phenomena can produce long-term effects even though the induced change is small. The general electro-mechano-chemical model presented predicts rectification phenomena and includes mechanical and electromechanical conformational change dynamics.

43663 (PB–89-188031/XAB) **Health-hazard evaluation report No. HETA-88-136-1945, Miller Thermal Technologies, Inc., Appleton, Wisconsin.** Moss, C.E.; Tubbs, R.L. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Jan 1989. 50p. (HETA–88-136-1945). Available from NTIS, PC A03/MF A01.

In response to a management request, a study was made of possible hazardous working conditions at Miller Thermal Technologies, Inc., Appleton, Wisconsin. Thermal arc spraying (TAS) was used at this facility to apply metal and plastic coatings to substrates. The maximum measured levels of actinic, visible, and infrared radiation measured at the thermal spray system were 22 microwatts/square centimeter (microW/sq cm), 16.7 candelas/sq cm, and 170 microW/sq cm, respectively. Octave band and weighted noise measurements indicated values in excess of 101 decibels-A during operation which indicated that exposure could last no more than 1 hour to be in compliance with NIOSH guidelines. Selected metal-fume samples indicated a potential for exposure to hazardous concentrations of nickel, chromium, and iron. The authors conclude that workers were exposed to potentially hazardous optical radiation, excessive noise levels, and concentrations of toxic metal fumes. The authors recommend the use of appropriate eye, respiratory, and hearing protective equipment. Recommendations are included concerning ventilation system improvements and emergency equipment provisions.

43664 (PB–89-863849/XAB) **Biological effects of electrical or magnetic field application. April 1987-May 1989 (Citations from the Life Sciences Collection data base). Report for April 1987-May 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 41p. Available from NTISPC N01/MF N01.

Supersedes PB–88-865506.

This bibliography contains citations concerning the application of electrical or magnetic fields to organisms. Changes in cell structure, cell shape, metabolism, mitosis, cell orientation, neuron response, germination response, and growth rates are discussed. The effect of electrical or magnetic fields from transmission lines is examined. Biological applications of electric fields cited include genetic transfer, plant cell fusion, and seed disinfection. (This updated bibliography contains 72 citations, 30 of which are new entries to the previous edition.)

43665 (PB–89-864938/XAB) **Noise control for motor vehicles. January 1970-June 1989 (Citations from the COMPENDEX data base). Report for January 1970-June 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 110p. Available from NTISPC N01/MF N01.

Supersedes PB–83-805440.

This bibliography contains citations concerning motor-vehicle noise reduction through peripheral systems, tire, muffler, engine, and body design. Automobiles, trucks, buses, motorcycles, and other mobile vehicles are studied. External noise pollution reduction and vehicle interior-noise reduction for driver and passenger safety and comfort are considered. Noise reduction in aircraft is discussed in a separate bibliography. (This updated bibliography contains 278 citations, 105 of which are new entries to the previous edition.)

57 HEALTH AND SAFETY

Refer also to citation(s) 41933

43666 (BNL–42659) **Internal audit criteria for industrial hygiene programs.** Brookhaven National Lab., Upton, NY (USA). Mar 1989. 86p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC02-76CH00016. Order Number DE89016124/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

An effective industrial hygiene program must comply with a variety of guidelines, regulations, and good practice procedures. New and changing regulations in the areas of toxic substances control, noise and hearing conservation, hazardous waste management, hazard communications, and cleanup of old disposal sites have added some extremely complex requirements. In response to these regulations, DOE instructions establish the basic requirements within DOE for conducting both functional and managerial appraisals of health and safety programs. Within this procedural framework, each DOE facility must conduct internal audits to assist in evaluating the effectiveness of the facility's industrial hygiene program and to identify potential noncompliance situations and future problem areas. This manual has been prepared for use by a DOE facility as an aid for conducting internal industrial hygiene program audit. The manual is organized in modular format, with each module covering a separate area of industrial hygiene. Each module has been structured to stand-alone with an overview, objective, scope, and interrogative checklist so that extensive time and effort need not be spent in developing narrative responses. For those questions requiring a written response, the reviewer is expected to supply only sufficient information to clarify an answer.

43667 (Juel-Conf–70) **Themes and tasks of risk communication. Proceedings.** Jungermann, H.; Kasperson, R.E.; Wiedemann, P.M. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). 1988. 193p. (CONF-8810410–: International workshop on risk communication, Juelich (Germany, F.R.), 17-20 Oct 1988). Available from Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek.

This volume presents a set of papers from an international workshop on 'Risk Communication'. Although the researchers represented a wide range of disciplines and nationalities, their common interest were the problems of communicating about risks, particularly for health and environment, resulting from the development and application of modern technological systems and procedures. Whereas most people today have come to realize that in a democratic political system there is simply no alternative to open, honest, and extensive information and communication, most people also have come to realize that this is an extremely difficult, and sometimes dangerous, task, because informing about risk has itself a high risk of failure. The workshop presented, for the first time in the FRG, the theoretical concepts, empirical findings, practical experiences, and some conclusions. (orig./HSCH).

43668 (Juel-Conf–70, pp. 11-31) **Media reporting of risk information: Uncertainties and the future.** Peltu, M. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). 1988. (CONF-8810410–: International workshop on risk communication, Juelich (Germany, F.R.), 17-20 Oct 1988). In *Themes and tasks of risk communication. Proceedings.* Available from Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek.

This paper argues that very little is known with a reasonable degree of certainty about how the media influence their audiences. Media effects are mediated through diverse, subtle social interactions and processes. Future changes in the regulatory and technological media environment will create even more uncertainty by changing basic parameters of media/audience interaction. More research is needed to help shed light on these uncertainties and

future changes. If this research is to be of relevance to real communicators of real risk, it must fully address the issues of how the media are influenced, not just media impacts. In this context, the role of experts, PR, advertising, and media professionals' motivations are key priorities. (orig.).

43669 (Juel-Conf–70, pp. 33-48) **The role of the media in risk communication.** Lichtenberg, J. (Maryland Univ., College Park (USA)); MacLean, D. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). 1988. (CONF-8810410–: International workshop on risk communication, Juelich (Germany, F.R.), 17-20 Oct 1988). In *Themes and tasks of risk communication. Proceedings.* Available from Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek.

This paper analyses the origins of risk communication; why the role of the media is difficult to study; the relationship between media coverage and public opinion; the relationship between media coverage and 'reality'; some dilemmas for journalists; the politics of risk communication. More research needs to be done on this issue. Because of the complexities advances will depend partly on cooperation among risk analysts, communications experts, political theorists and philosophers; in any case, progress is likely to be slow and the research costly. The paper demonstrates: It matters greatly that journalists and the rest of us understand the context and the consequences of press coverage of risk issues. (orig./HSCH).

43670 (Juel-Conf–70, pp. 105-121) **Rights and duties concerning the availability of environmental risk information to the public.** Baram, M.S. (Boston Univ., MA (USA)). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). 1988. (CONF-8810410–: International workshop on risk communication, Juelich (Germany, F.R.), 17-20 Oct 1988). In *Themes and tasks of risk communication. Proceedings.* Available from Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek.

Both American and European societies are moving in the same direction - towards greater recognition of the need to make risk information available to the public, and greater reliance on communication as a policy instrument for reducing technological hazards. The American approach has been more expansive in providing information rights to the public and promoting public involvement in solving technical risk problems; but has not paid sufficient attention to actual performance problems, such as how to resolve disputes and systematically provide equivalent safety to all persons. The European approach has sought to maintain traditional joint responsibility of industry and government for systematically solving problems, but has resisted conferring public rights of access to industrial information which would permit the public to effectively participate in the development of the programs to prevent and respond to accidents. One can only conclude that each industrial society has much to learn from the other. (orig./HSCH).

43671 (Juel-Conf–70, pp. 155-157) **Results of the Working Group 'Risk Communications for Emergencies and Disasters'.** Sorensen, J.H. (Oak Ridge National Lab., TN (USA)); Dombrowsky, W.R. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). 1988. (CONF-8810410–: International workshop on risk communication, Juelich (Germany, F.R.), 17-20 Oct 1988). In *Themes and tasks of risk communication. Proceedings.* Available from Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek.

Enhancing crisis communication is important to industry, government and the public. The public is becoming increasingly concerned about technological failures as our reliance on technology increases. Better preparedness and more public awareness can increase public acceptance of and confidence in ability to manage high consequence technologies including ability to manage its failures. Failed communications in emergencies has increased the loss of life and property and public scepticism. Effective communication can (a) engender confidence and trust in authorities; (b) give rise of acceptance of risks and risk management and (c) reduce the consequences of disasters. (orig./HSCH).

43672 (Juel-Conf–70, pp. 163-168) **Hazard versus outrage: A conceptual frame for describing public perception on risk.** Sandmann, P.M. (Rutgers - the State Univ., New Brunswick, NJ (USA)). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). 1988. (CONF-8810410–: International workshop on risk communication, Juelich (Germany, F.R.), 17-20 Oct 1988). In *Themes and tasks of risk communication. Proceedings.* Available from Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek.

This is the fundamental premise of the author's argument: People's concerns and fears are more a product of outrage than of hazard. That is, we consistently underestimate the hazard of risks that are low-outrage, and overestimate the hazard of risks that are high-outrage. Everyone does this, even risk assessment experts when they are outside their own fields. The ability of risk assessment experts to define risk in terms of hazard and make it stick is an example of the power of expertise. Instead of comparing public perception of risk to expert knowledge it helps to see this as two different definitions of what risk means - the definition experts use on the job, which ignores outrage, versus the definition in everyday use, which emphasizes outrage. (orig./HSCH).

43673 (RVH–165D286) **Pathophysiology of surgical treatment of high voltage electrical injury.** Daniel, R.K. Royal Victoria Hospital, Montreal, PQ (Canada). 1988. 109p. (CE–02622). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An experimental triphasic electrical injury model was developed in a primate showing injuries comparable to the clinical setting. This allowed easy, unobstructed evaluation of a reproducible upper extremity electrical injury. In the acute pathophysiology portion of the project, current repartition, temperature elevations, and voltage drops were evaluated. Experiments revealed an uneven flow of current through major muscle groups in the upper extremity. Average temperature elevations in areas corresponding to tissue necrosis were found to be significantly higher than those in viable tissues. Current passage through highly resistant bone and tendinous structures at the wrist and elbow were associated with significant potential drops. In the chronic portion of the project, an electrical burn model employing documentary and diagnostic techniques was designed in the primate to enable investigation of wound evolution for up to 10 days post burn. The techniques used to assess the electrical injury were gross observation, light microscopy, histochemistry and intracellular biochemistry, digital subtraction angiography, and ulnar nerve recordings. Characteristic patterns of tissue injury were recorded. No evidence was found to support the concept of progressive necrosis. This report is illustrated with numerous photographs, but the animals themselves are not presented or represented. A bibliography on electrical injuries is given. 54 refs., 29 figs., 1 tab.

43674 (VTT-TUTK–584) **Major hazards in industrial processes.** Pipatti, R. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Feb 1989. 171p. (In Finnish). Order Number DE89902339/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Major hazards in the Finnish chemical and process industries have been studied in the project. Risk factors associated with the process have been studied. Protective systems have not been considered. The probabilities of the accidents have not been estimated. The influence of factors like material properties, reaction types, process conditions and equipment on risks have been studied. Accidents that have happened in Finland and abroad have been studied to find factors that cause accidents and influence the consequences. Even accidents with only minor consequences and near misses have been studied. Major accidents are often caused by a series of technical and human faults. By preventing minor accidents one also prevents major accidents from happening. Industrial accidents are explosions, fires and releases of toxic or otherwise harmful materials to the environment. The major hazards of Finnish processes have been estimated from process descriptions. In accident prevention it is important to know the process hazards and to identify the risk factors. By using methods of risk analysis and laboratory tests you can prevent most of the accidents. The best results are achieved when one identifies the risks in the planning phase of the process.

58 GEOSCIENCES

Refer also to citation(s) 42499, 42627, 42710

5801 Geology and Hydrology

Refer also to citation(s) 41510, 41511, 41745, 41795

43675 (DOE/NV/10322–37) **Geology of the U-1a.01 horizontal drift complex, southwestern Yucca Flat, Nevada Test Site.** Drellack, S.L. Jr.; Thompson, P.H.; Rayburn, C.J. Fenix and Scisson, Inc., Mercury, NV (USA). Mar 1989. 69p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-84NV10322. Order Number DE89015380/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The U-1a.01 complex, site of a Los Alamos National Laboratory-sponsored experiment, is located in southwestern Yucca Flat on the Nevada Test Site. The complex is comprised of the vertical U-1a shaft, two large-diameter cable access holes, and approximately 229 m (750') of horizontal drift mined within alluvium 292.6 m (960') below the surface. Geologic mapping and related work at U-1a.01 afforded a unique opportunity to observe and evaluate the characteristics of alluvium in the subsurface of Yucca Flat, and to compare the results with surface and drill hole alluvium data. The Los Alamos Support Group of the Fenix and Scisson, Inc. Geology and Hydrology Division carried out a program of mapping, sampling and photography while mining was in progress, with the dual purpose of characterizing the geology of the site and documenting the mining operation. This report details the products and the results of that effort. 12 refs., 8 figs., 25 tabs.

43676 (SGS–9, pp. 77-82) **The Madison, a nomenclatural review with a look to the future.** Carlson, C.G. (North Dakota Industrial Commission, Bismarck, ND, USA); Lefever, J.A. Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5th international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The difficulty of extending nomenclature applied to Madison strata of the outcrops in Montana into the subsurface in the Williston basin was recognized early and led to the addition of the Charles Formation ot the Madison Group in the subsurface of eastern Montana. Recognition of facies changes across the Basin led to the use of marker horizons to delineate marker-defined units within Madison strata on the east flank of the Basin. Numerous terms were introduced for marker-defined units and different horizons were used in different areas for similar terms. Exploration has now provided a means for establishing the stratigraphic relationships of the marker-defined units, and a review of the stratigraphic code provides a basis for clarifying nomenclature. It is herein proposed that the lithostratigraphic terms Madison Group, Charles, Mission Canyon, and Lodgepole Formations be retained as formal stratigraphic units. The facies relationships of the evaporites and carbonates are recognized by placing the Charles-Mission Canyon contact at progressively lower stratigraphic horizons towards the east flank of the Basin, so that the lowest evaporites are in the Charles Formation. The marker-defined units or marker horizons are considered informal units and may be referred to as intervals, subintervals, cycles, formats, marker horizons, or facies. 31 refs 3 figs

43677 (SGS–9, pp. 83-97) **Corals from the Madison Group, Williston Basin, North Dakota.** Waters, D.L. (ARCO Alaska Inc., Anchorage, AK, USA); Sando, W.J. Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5th international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Corals are among the few fossils that have proved useful for dating and correlating Mississippian rocks in the Williston Basin. Study of cores from the Madison Group (Mississippian) in 29 wells in the Williston Basin of North Dakota revealed a coral fauna represented by eleven species and four morpho-groups belonging to the genera Amplexocarinia, Amplexizaphrentis, Cyathoxonia, Lophophyllum, Michelinia, Siphonodendron, Stelechophyllum, Synchoelasma, Syringopora, and Vesiculophyllum. Four zonules based on corals are sueful for correlation of Mississippian rocks within the area studied. Stelechophylum micrum and S. banffense are recorded in the conterminous United States for the first time. 40 refs 8 figs

43678 (SGS–9, pp. 98-106) **Waulsortian-type mounds in the Mississippian of the Williston Basin. New interpretation from old cores.** Sereda, R.D. (Univ. of Saskatchewan, Saskatoon, SK, Canada); Kent, D.M. Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5. international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

There has been some speculation on the existence of Waulsortian-type mounds in the Mississippian formations of the Williston Basin but, to date, little evidence has been found to make any positive identification. Location and recognition of mounds in the subsurface can be based on the geometry and composition of outcropping mounds of Mississippian to Permian ages in various parts of the Rocky Mountain region, as well as on their paleogeographic and paleotectonic settings. Mounds in the Mississippian of the Williston Basin sould be expected on positive elements created by repeated basement block paleotectonic or syn-depositional salt solution. Two cores from the Souris Valley beds of extreme southeastern Saskatchewan contain lithologies that can be interpreted as representing mound or associated strata. One core contains unstratified lime mudstones with crinoidal debris in a geological setting in which surrounding cored wells reveal thinly bedded typical slope lithologies. The second core consists of streeply dipping crinoidal debris in a geological setting in which surrunding cored wells reveal thinly beded typical slope lithologies. The second core consists of steeply dipping crinoidal grainstones and packstones. Neither core features well developed reservoir rock, but Waulsortian-type mounds yield oil elsewhere. The reservoir potential of mounds in the Williston Basin depends on porosity enhancement by either dolomitization or exhumation of primary porosity by solution of pore-filling cements. 36 refs., 12 figs.

43679 (SGS–9, pp. 68-76) **Summary of the biostratigraphy of the Bakken Formation (Devonian and Mississippian) in the Williston Basin, Noth Dakota.** Holland, F.D. (Univ. of North Dakota, Grand Focks, ND, USA); Hayes, M.D.; Thrasher, L.C.; Huber, T.P. Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5. international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Originally described as Mississippian, the Bakken Formation has been correlated with both Devonian and Mississippian outcropping units in nearby states and provinces. Studies of 95 form-species of conodonts and more than 500 macrofossils in 50 taxa from 30 cores now allow more accurate Bakken biozonation in North Dakota. The Bakken, up to 45 m thick, is as old as the Late Famennian Lower Palmatolepis gracilis expansa Biozone and as young as the Kinderhookian Lower Siphonodella crenulata Biozone. A lower, black-shale member, <16 m thick, has a brachiopod fauna in the bottom meter, conodonts perhaps as old as the Lower Palmatolepis perlobata postera Biozone, the alga Foerstia 2 m above the base, and abundant conchostracans marking the top. A middle member, lacking age-diagnostic conodonts, has been divided into three lithologic units. The systemic boundary has been placed at the base of

the second unit of the middle member. An upper black-shale member contains Siphonodella sulcata at the base, rare macrofossils, and perhaps as many as three Kinderhookian conodont biozones. Deposition of the upper member of the Bakken may have begun as early as the time of the late Upper S. duplicata Biozone although, more likely, it began in the time of the Lower crenulata Biozone. This biozone is represented in both the upper member of the Bakken and the lower part of the Lodgepole Formation. Above this, suggestion of the S. isosticha-Upper S. crenulata Biozone was found in the Lodgepole; but conodont numbers dwindled rapidly to disappearance by 15 m above the base of the Lodgepole, before the Kinderhookian-Osasgean boundary was reached. 69 refs 4 figs

43680 (SGS–9, pp. 37-46) **The Winnipegosis Formation of the northeastern margin of the Williston Basin.** Rosenthal. L.R. (Brandon Univ., Brandon, MB, Canada). Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5. international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This study compiles a series of observations from outcrop exposure and drill cores of Winnipegosis strata in the Manitoba outcrop belt and proposes a depositional/diagenetic model which might aid explorationists working in the subsurface. The Winnipegosis is part of the Upper Elk Point (middle Devonian) formation that extends through Alberta and Saskatchewan. The Winnipegosis buildups studied in this report were deposited in a relatively deep marine basin flanking a broad carbonate platform. Four distinct lithostratographic facies are described, in ascending order: the Ashern Formation, the upper and lower Winnipegosis members, and the Prairie Evaporite residual clay horizon. Within these units, eight depositional facies are identified on the basis of primary textures, and two additional diagenetic facies which retained no relic depositional textures are also recognized. Interpretation of the depositional environment for each facies is given. An integrated core-outcrop model for Winnipegosis carbonates in Manitoba is then presented, and implications for exploration in the northern Williston Basin discussed. Points to be considered are the presence of true organic reefs, the lack of interdigitation of buildup and basin facies, and the fact that porosity is enhanced in, but not restricted to, the organic framework. 24 refs., 10 figs.

43681 (SGS–9, pp. 117-122) **Cyclicity in the Mission Canyon and lower Charles Formations of the central Williston Basin.** Hoff, J.L. (Univ. of North Dakota, Grand Forks, ND, USA). Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5th international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Statistical analysis was performed on 414 m of core from two formations in the Williston Basin. Carbonate and sulfate lithologies from the Ratcliffe, Frobisher-Alida, and Tilston intervals were sampled and examined for the presence of cyclicity. Presence-absence data were collected for 50 lithologic components. Similarity measures were calculated using the phi association coefficent. Unweighted pair-group mean clustering was performed on the similarity matrices. The significance of clusters was tested and clusters significant at the 99% level have distinct lithologic identities and are interpreted as lithofacies. Lithofacies were used as the mutually exclusive states required by numerical analysis of cyclicity. Iterative, simultaneous use of embedded Markov chain and mutual substitutability analyses was followed by examination of relative entropy patters. Markov property was determined to be present in each of the three wells studied. Two or more pairs of states were found to be mutually substitutable in each well. In all wells, patters of Markov dependencies were resolved into two cycles. Entropy patterns for all wells suggest that cyclicity in the central Williston Basin is symmetrical. No conclusions can be drawn from the depth distribution of lithofacies in well 7207. The stratigraphic distribution of lithofacies forming cycles in wells 793 and 1262 shows a clear and abrupt change from the more restricted marine facies in the upper portion of the cored interval, to the echinoderm-bearing carbonates or oolitic facies. This indicates abrupt rather than gradual introduction of more evaporative facies and control of upper and lower cyclicity by separately operating depositional mechanisms. 12 refs 7 figs 2 tabs

43682 (SGS–9, pp. 123-133) **Depositional cycles in the Mississippian Mission Canyon Limestone and Charles Formation, Williston Basin, North Dakota.** Waters, D.L. (ARCO Alaska Inc., Anchorage, AK, USA); Sando, W.J. Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5th international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Study of 29 cores from wells in the Mission Canyon Limestone and Charles Formation resulted in recognition of five lithologic suites and two lithologic subsuites in each of three of these suites. These lithologic suites and subsuites represent the following depositional environments and subenvironments: supratidal-intertidal environment having sabkha, tidal flat and evaporitic ponds, and lagoons; intertidal environment which can, in some places, be differentiated into a subenvironment of low-energy accumulations of tidal ponds, drowned tidal flats, and possibly lagoons, or a subenvironment of higher-energy accumulations of shoals and tidal channels; restricted marine environment; transitional zone differentiated into a transitional zone between the restricted marine environment and open-marine environment; open-marine environment differentiated into a low-energy open-marine subenvironment, and a higher-energy open-marine subenvironment representing offshore shoals or submarine banks. Three regressive carbonate cycles that correspond to the Tilston, Frobisher-Alida, and Ratcliffe intervals of the upper part of the Madison are recognized. Each cycle shows a similar sequence of lithology, beginning at the base with rocks deposited under open-marine conditions and followed by rocks deposited in progressively shallower marine environments culminating at the top with rocks deposited in intertidal and supratidal environments. 19 refs 14 figs 1 tab

43683 (SGS–9, pp. 147-156) **Structural evolution of the central and southern portions of the Nesson Anticline, North Dakota.** Lefever, J.A. (North Dakota Geological Survey, Grand Forks, ND, USA); Lefever, R.D.; Anderson, S.B. Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5th international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Nesson Anticline is the largest producing structural feature in the North Dakota portion of the Williston Basin. All of the Paleozoic formations which occur in the Williston Basin are present along at least part of the anticline and, of these, 14 produce in a total of 54 fields. Data were collected from oil well wireline logs along the portion of the anticline from Beaver Lodge Field to its southernmost extension in Rattlesnake Point Field. A total of 45 formation tops were picked from about 1300 well logs. From these data, isopach maps and structure contour maps were constructed for each of the formations. Where there were enough control points away from the structure, structural relief was determined. The Nesson Anticline in the study area is predominantly a north-south trending structure with slight irregularities in direction along the hinge trace. The fold opens up to the south, where it splits into several smaller secondary folds. Two faults are apparent from the structure maps: the main western Nesson fault which extends the length of the structure, and a fault on the northeast side of the Antelope anticline. There are

nine recognizable areas on the Nesson anticline in the study area. Structural activity in each area seems to have been essentially independent of the other areas. In most of the areas, the greatest movement along the anticline occurred during Devonian or Early Mississippian time, although there are some exception. Significant movement may have occurred prior to deposition of the Ashern formation, but the available data are too few to allow that interpretation. Structural activity in most areas appears to have been episodic, with few instatnce of prolonged movement. 10 refs 5 figs 3 tabs

43684 (SGS–9, pp. 157-168) **Salt dissolution and tectonics, south-central Saskatchewan.** McTavish, G.O. (Univ. of Regina, Regina, SK, Canada); Vigrass, L.W. Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5th international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Subsurface dissolution of the Middle Devonian Prairie evaporite is a major structure-forming process in south-central Saskatchewan. The dissolution phenomenon is a multistage process of salt removal that entails collapse of the overlying sedimentray column and accelerated sedimentation into surface depressions produced during collapse. The process is important because it affects the sedimentation and diagenesis of younger strata and may produce structures suitable for petroleum entrapment. Linear dissolution trends which migrate laterally with time occur within the South Regina and Hummingbird Troughs. Analysis of structure contour, isopach and residual maps has yielded a chronology of dissolution events. Salinities (TDS) increase and hydraulic heads decrease as one moves eastward from a large salt-free area into the main salt body. Both composition of subsurface waters and fluid pressures suggest an upwelling of formation waters within the Hummingbird Trough. Within the map-area, two differing situations appear to affect salt dissolution. In the northeast, salt removal appears to be localized above porous and permeable Winnipegosis mounds of the Elk Point Basin. In the southwestern part of the study-area, underlain by the Winnipegosis marginal carbonate shelf, it seems likely that dissolution was localized by fracturing associated with diastrophic (deep-seated) structures.

43685 (SGS–9, pp. 169-177) **Structural history of Poplar Dome and the dissolution of Charles Formation salt, Roosevelt County, Montana.** Orchard, D.M. (BHP Petroleum (Americas) Inc., Englewood, CO, USA). Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5th international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Poplar Dome, in western Roosevelt County, Montana, is a major structural feature of the western Williston Basin. Approximately 150 ft of structural closure exists at the Mississippian Ratcliffe horizon. Minor structural movement occurred in the area of Poplar Dome during Mississippian through Cretaceous time. Much of the present structural relief is the result of Laramide uplift. Beds of salt in the Mississippian Charles Formation (Poplar interval) abruptly pinch out at Poplar Dome. Over 300 ft of salt from regionally extensive beds is missing on and near the structure. Nonsalt beds, however, extend across the dome with little thickness change and few facies changes. The stratigraphic evidence along with the presence of breccia in cores indicate that the salt beds were originally present on Poplar Dome but were subsequently dissolved. The dissolution was probably a Tertiary event caused by the introduction of fresh water along fractures induced by uplift. The removal of the salt caused collapse over the dome which affected the structural configuration of beds younger than the Charles Formation. In addition to the dissolution of salt beds, pore-filling salt has been dissolved from limestone of the Charles A and B units. The dissolution of this salt from Charles A porosity is related to the removal of bedded salt, while the flushing of salt from the Charles B porosity is related to a regional dissolution front encroaching from the southwest. Poplar Dome is the site of a major oil field which has yielded more than 45 million bbl of oil, primarily from the Charles B porosity. The removal of pore-filling salt from the Charles B was a critical factor in creating this oil accumulation. The removal of salt beds also allowed the upward migration of oil into reservoirs of the Charles A and the Pennsylvanian Tyler Formation. 20 refs 14 figs

43686 (SGS–9, pp. 107-116) **Environmental significance of a megaspore flora from the Mission Canyon Formation (Mississipian), Bottineau County, North Dakota.** Luther, M.R. (Univ. of North Dakota, Grand Forks, ND, USA); Steadman, E.N.; Hills, L.V. Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5. international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Megaspores and unidentified plant fragments have been recovered from two thin (0.5 m - 1.5 m) zones within carbonates of the Frobisher-Alida interval of the Mississippian Mission Canyon Formation. This flora was found during a study of the Wiley Field, southwestern Bottineau County, North Dakota. At least five new forms of megaspores were found, and are believed to represent previously underscribed genera and species of arborescent lycopods. Arborescent lycopods are typically associated with freshwater environments. The remarkable preservation, low diversity, and apparent areally restricted concentration of megaspores indicate growth at or near the place of deposition. This may provide evidence for local subaerial exposure and fresh-water lens development. Preserved organic fragments were deposited in nearby topographic lows. Organic plant and scolecodont material was preserved in an anoxic shallow water setting probably caused by saline brines. These brines dolomitized the sediments in which the organic material was preserved before significant compaction had occurred. 8 refs., 12 figs.

43687 (SGS–9, pp. 134-146) **A reconnaissance sedimentological study of the middle Jurassic upper Shaunavon Formation, southwest Saskatchewan.** Wilson, R.C.L. (The Open Univ. Milton Keynes, England). Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5. international Williston Basin symposium, Grand Forks, U (USA), 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Upper Shaunavon (15-25 m) is a mixed siliciclastic-carbonate unit. In the Rapdan and Dollard oilfield areas the lower part consists of quartz sands, calcareous shales, skelatal/peloidal packstones and grainstones that probably represent reworked relict sediments of a transgressive barrier island system. In the Instow-Bone Creek area the lower part is dominated by skeletal and ooid grainstones, some of which are producing reservoirs. Reservoir beds in the middle and upper parts consist of quartz and skeletal sands. Their porosity is enhanced by aragonite dissolution, and early freshwater phreatic calcite cement fringes ensured that little reduction of porosity occurred due to compaction during burial. Dolomitic sediments beneath, and on the flanks of reservoir units may have partially originated in the fresh-marine mixing zone, but some show features suggestive of an evaporative origin. The results of this study are consistent with earlier interpretations that envisage a north northeast-south southwest trending coastal barrier system. However, further detailed study of slabbed cores is needed to establish the extent to which wave and tidal processes sculptured Shaunavon reservoir units. 20 refs., 11 figs.

5802 Geophysics

43688 (AD-A–205646/3/XAB) **Parallel processing for transient nonlinear structural dynamics of three-dimensional framed structures using domain decomposition.** Hajjar, J.F.; Abel, J.F. Cornell Univ., Ithaca, NY (USA). Mathematical Sciences Inst. 1988. 19p. Available from NTIS, PC A03/MF A01.

Pub. in Computers and Structures, Vol. 30, No. 6, 1237-1254(1988).

Nonlinear transient analysis of structures subjected to dynamic earthquake loading provides vital information for design and research. A strategy is presented for the solution of the fully nonlinear transient structural dynamics problem in a coarse-grained parallel-processing environment. Emphasis is placed on the analysis of three-dimensional framed structures subjected to arbitrary dynamic loading and, in particular, steel-building frames subject to earthquake loading. Concerns include long duration dynamic loading, geometric and material nonlinearity, and the wide distribution of vibrational frequencies found in frame models. The implicit domain decomposition method described employs substructuring techniques and then a preconditioned conjugate gradient algorithm for the iterative solution of the reduced set of unknowns along the substructure interfaces. Substructuring is shown to provide a natural preconditioner for effective parallel iterative solution.

43689 (AD-A–205986/3/XAB) **Dynaflow user's guide.** Prevost, J.H.; Slyh, R.; Hager, K. Naval Civil Engineering Lab., Port Hueneme, CA (USA). Nov 1988. 485p. (NCEL-UG–0014). Available from NTIS, PC A21/MF A01.

The Navy has $25 billion worth of facilities in seismically active regions. Each year $200 million of new facilities are added to those in seismically active areas. The Navy, because of its mission, must locate at the waterfront with a high watertable and often on marginal land. Seismically induced liquefaction is a major threat to the Navy. Presently, procedures do not exist to analyze the effect of liquefaction on structures. Developing an effective stress soil model will provide a tool for such analysis of waterfront structures. To understand the significance of liquefaction, it is important to note the damage caused in recent experiences. This study is directed toward examining the predictive capabilities of the numerical procedure proposed in a previous work titled studies of the capabilities of a soil model to predict axial drained/undrained responses of two sands.

43690 (AD-A–206979/7/XAB) **SeisMs.NORSAR: a seismic monitoring system. (User's guide). Final technical report, 1 March 1985-30 September 1988.** Science Horizons, Inc., Encinitas, CA (USA). 9 Nov 1988. 120p. (SH-R–4-88-2112). Available from NTIS, PC A06/MF A01.

SeisMs.NORSAR, a seismic monitoring system that is part of a joint effort by Norway and the United States is developed to relay real-time data streams generated from the ARCESS array located at Finmark (Karasjok) to the NORSAR acquisition site located at Kjeller, Norway. SeisMS. NORSAR consists of a communications hardware/software subsystem called a Communications Interface Module (CIM) and a near-real-time software subsystem for automated acquisition and processing of the seismic data. One CIM located at ARCESS receives the real-time array (hub) and high-frequency (HF) data streams, multiplexes them and retransmits the stream by satellite to the NORSAR sites. At NORSAR, a receiving CIM demultiplexes the data, buffers it if necessary, and relays the hub and HF data streams to a DCP board in a Sun Workstation. Data-acquisition software running in the workstation, diverts each data stream onto a circular buffet disk loop, from which all or selected portions of the raw data can be reformatted to conform to a CSS data base and archived to tape or written to a CSS database and archived to tape or written to a CSS data base on disk. This report includes information on CIM reference, CIM maintenance, using the data-acquisition software, and manual (man) page for user commands and required input file formats.

43691 (AD-A–207046/4/XAB) **Earthquake-induced liquefaction of fine-grained soils - considerations from Japanese research. Final report, October 1986-September 1988.** Koester, J.P.; Tsuchida, T. Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Geotechnical Lab. Dec 1988. 51p. (WES/MP/GL–88-34). Available from NTIS, PC A04/MF A01.

Liquefaction potential of various types of soils has received a great deal of research attention in the geotechnical community over the previous two decades. Dramatic occurrences of liquefaction in saturated deposits of fine, uniformly graded sands in the Japanese city of Niigata and surrounding areas resulting from ground shaking during the 16 June 1964 earthquake spawned extensive studies to develop methodologies for assessing the potential for liquefaction of predominantly clean sands throughout Japan and worldwide. Japanese researchers have recently performed laboratory and field studies to assess the influence of variations in grain-size distribution and soil-index properties of liquefaction potential of fine-grained soils. Several Corps of Engineers dams in seismically active areas are founded on fine-grained, low plasticity alluvial deposits. This report reviews current practices applied to study the phenomenon of fine-grained soil liquefaction, with emphasis on recent Japanese laboratory and in situ testing research. The findings will promote efficiency of effort in the conduct of subsequent laboratory-testing efforts toward the development of specific procedures for use by the Corps and others in assessing the potential for earthquake-induced liquefaction to occur in fine-grained soils.

43692 (CEA-DAS–599) **Stong movements data and simple criterion of damages.** Ferrieux, H. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. May 1989. 10p. (In French). (CONF-8904262–: 2. National Symposium on paraseismic engineering, 18-20 Apr 1989). Order Number DE89908185/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

When studying, from a statistical point of view, the damage that may be inflicted upon a heterogeneous population of structures without having recourse to the computation of the response of each, one considers ground motion parameters believed to be representative of the 'destructive potential' of the motion in question. In this study, an overview is made of the principal correlations that have been established between these different parameters and the damage observed, then new ones are elaborated and their relative value and realm of applicability are determined.

43693 (CEA-DAS–600) **Application test of data analysis for the research of a tectonic zoning of France.** Delouis, B.; Brenot, J.; Combes, P.; Goula, X.; Grimoud, J. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. May 1989. 10p. (In French). (CONF-8904262–: 2. National Symposium on paraseismic engineering, 18-20 Apr 1989). Order Number DE89908184/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Up to now, characterization of homogeneous tectonic zones results essentially from the superposition of different geological thematic maps; with this approach, a tectonic zoning of France was established. A method of data analysis (principal components analysis) is used to study the statistical relationships between different factors describing the state of the earth crust in France; a tectonic picture is obtained which is compared with the previous zoning.

43694 (CEA-DAS–601) **Prevision of high seismic movements from studies on weak movements: methodological review.** Mohammadioun, B. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. May 1989. 10p. (In French). (CONF-8904262–: 2. National Symposium on paraseismic engineering, 18-20 Apr 1989). Order Number DE89908183/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

In most seismic areas of the world, the major earthquakes occurring there have not been recorded in the near field by adequate instruments. The calculation of seismic motion for engineering purposes, to be used in the anti seismic design of sensitive facilities, is accordingly based upon data mainly from California, and which bear the mark of the seismotectonic features of this part of the world. On the other hand, various seismic monitoring networks in France and neighboring countries have made it possible to put together an extensive collection of moderate-magnitude recordings. The object of this contribution is to conduct a critical analysis of the methods called upon in the prediction of strong ground motion that use European moderate-magnitude earthquake data, which, as in the case of severe earthquakes, reflect their corresponding path effect. This

analysis focusses more particularly on the degree of validity of the hypotheses involved in the aforementioned predictions.

43695 (ENEA-RT-PAS–85-3) **ENEA Southern Latium (Italy) seismic array.** Cervellati, R.; Cochi, C.; Vitiello, F. ENEA, Casaccia (Italy). Dipt. Protezione Ambientale e Salute dell'Uomo. Mar 1985. 74p. (In Italian). Order Number DE89761958/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The planning and development of ENEA's (Italian Commission for Nuclear and Alternative Energies) Southern Latium Seismic array are described. The paper describes the geology of the region and discusses why ENEA chose this area to carry out seismotectonic research. It contains a detailed description of each seismic station and the signal teletransmission method, which made possible the coverage of an uneven orographic area with a point-to-point radio relay system. Finally it describes the acquisition of seismic data in Casaccia.

43696 (ENEA-RT-PAS–85-6) **Electric grounding for ENEA (Italy) seismic array.** Cervellati, R.; Vitiello, F. ENEA, Casaccia (Italy). Dipt. Protezione Ambientale e Salute dell'Uomo. Apr 1985. 17p. (In Italian). Order Number DE89761959/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The paper describes the earthing system employed to shield the ENEA (Italian Commission for Nuclear and Alternative Energies) seismic stations from atmospheric discharges. The system was used for the seismic arrays of Southern Latium and Brasimone, Italy. The initial implementation of this system was carried out with excellent results.

43697 (INFO–0265) **Neotectonics in the maritime provinces.** Martin, G.L. Atomic Energy Control Board, Ottawa, ON (Canada). Mar 1988. 123p. Order Number DE89635115/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

Seismic risk assessment in the Maritime Provinces requires input from not just historical, but also geological sources. A detailed search through published and unpublished geological literature reveals many examples - some probable, some possible -of neotectonic movement in the area. Examples range in tectonic significance from those that reflect exaggerated local imbalance to those that signify deep-seated stress. Evidence for neotectonism in the Maritimes is multidisciplined. It includes deformation in bedrock and quaternary deposits, and regional warping. Recent movement also is indicated by changes in relative sea level, in situ stress fields and geodetic fluctuations. Finally, and most unequivocally, neotectonism in the Maritime Provinces is manifested as the seismic events that have sporadically affected the area throughout its recent geological history, and continue up to the present day. 288 refs.

43698 (PB–89-178826/XAB) **Cone penetration testing for evaluating the liquefaction potential of sands. Master's thesis.** Carter, R.R. Bureau of Reclamation, Denver, CO (USA). May 1988. 69p. (REC-ERC–87-9). Available from NTIS, PC A04/MF A01.

Before the Niigata and Alaskan earthquakes of 1964, most geotechnical engineers had expressed little concern about the dynamic behavior of saturated sand layers. Regardless of their density, sands were generally considered quite incompressible and stable for foundation and construction uses. The only disadvantages for the universal use of sands considered were the consequences of their high permeabilities. Damage to many structures founded on saturated sand beds and other physical signs of loss of strength in sand layers during the two 1964 earthquakes resulted in the formation of a new area of geotechnical engineering. A new term, 'liquefaction,' was coined to describe the more visible outcomes of earthquake-related failures.

43699 (SKB-TR–89-01) **Near-distance seismological monitoring of the Lansjaerv neotectonic fault region. Pt. 2: 1988.** Wahlstroem, R.; Linder, S.O.; Holmqvist, C.; Maartensson, H.E. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Jan 1989. 23p. Order Number DE89912024/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

During five months in 1988, a mobile seismic network (six stations) was operated near the Lansjaerv neotectonic fault in Swedish Lapland. This was a continuation of an investigation in the same area in 1987. Some 30 local earthquakes were recorded, 18 of which have been located. A restrained focal depth has been obtained for six of these, and the depths range from 5 to 12 km. There is no clear spatial association of the earthquakes with the lateglacial fault segments, but many epicentres lie close to an older fault with the trend perpendicular to that of the lateglacial fault segments. Seismic moments from 10^{10} to 10^{12} Nm, fault radii 30-100 m, average dislocations 0.03-3 mm and stress drops 0.01-4 MPa have been computed from Sg-wave amplitude spectra. Focal mechanisms are not well constrained due to the small number of stations, and their tectonic interpretation is uncertain. (orig.).

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Refer also to citation(s) 41697, 41698, 42694, 43703, 43704

43700 (EMR/MR–88-128) **Results of shear testing on jointed Paradise River specimens.** Jackson, R. Canada Centre for Mineral and Energy Technology, Ottawa, ON (Canada). Mining Research Labs. [1989]. 46p. (MICROLOG–89-02174). Available from Canada Centre for Mineral and Energy Technology, Technical Information Division, 562 Booth St., Room 20C, Ottawa, ON, CAN K1A 0G1; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Direct shear tests were conducted on seven jointed banded tuff specimens obtained from the Paradise River hydro-electric project by ShawMont Newfoundland Limited. The specimens constituted two sets of joint types, planar and kink banded. Shearing was performed under normal loads of 500, 1000, and 1500 kilopascals for each joint type. 1 ref., 25 figs., 2 tabs.

43701 Mechanics of slip and fracture along small faults and simple strike-slip fault zones in granitic rock. Martel, S. J. (Earth Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California (US)); Pollard, D. D. *Journal of Geophysical Research (USA)*, 94(B7): 9417-9428 (10 Jul 1989).

We exploit quasi-static fracture mechanics models for slip along pre-existing faults to account for the fracture structure observed along small exhumed faults and small segmented fault zones in the Mount Abbot quadrangle of California and to estimate stress drop and shear fracture energy from geological field measurements. Along small strike-slip faults, cracks that splay from the faults are common only near fault ends. In contrast, many cracks splay from the boundary faults at the edges of a simple fault zone. Except near segment ends, the cracks preferentially splay into a zone. We infer that shear displacement discontinuities (slip patches) along a small fault propagated to near the fault ends and caused fraturing there. Based on elastic stress analyses, we suggest that slip on one boundary fault ends and caused fracturing there. Based on elastic stress analyses, we suggest that slip patches preferentially led to the generation of fractures that splayed into the zones away from segment ends and out of the zones near segment ends. We estimate the average stress drops for slip events along the fault zones as ~1 MPa and the shear fracture energy release rate during slip as 5×10^{2}–2×10^{4} J/m^2. This estimate is similar to those obtained from shear fracture of laboratory samples, but orders of magnitude less than those for large fault zones. These results suggest that the shear fracture energy release rate increases as the structural complexity of fault zones increases. © American Geophysical Union 1989

43702 Transport of fluid and electric current through a single fracture. Brown, S. R. (Geomechanics Division, Sandia National Laboratories, Albuquerque, New Mexico (US)). *Journal of Geophysical Research (USA)*, 94(B7): 9429-9438 (10 Jul 1989).

One expects the hydraulic and electrical conductivities of rock to be related, since there is an analogy between the differential equations describing each process. Fractures in rock are commonly described by the parallel plate model, where the fracture surfaces are smooth and parallel with a separation or aperture of d. For this model the hydraulic conductivity is proportional to d^3, whereas the electrical conductivity is proportional to d. Deviations from the parallel plate model are expected, since real fracture surfaces are rough and in partial contact. Computer simulations of fluid flow and conduction of electricity were performed on simulated fractures

composed of rough surfaces generated with a fractal algorithm. The finite difference method was used to calculate the volume flow rate and electric current. This solution was used in the parallel plate model to get an effectie hydraulic aperture d_h and electric aperture d_e. The electric and hydraulic apertures are nearly the same when the surfaces are widely separated. However, d_e is always smaller than d_h, with the difference increasing as the fracture closes. Additionally, the local directions of fluid flow and electric current are not the same. Thus contrary to the common assumption, the actual path length of a fluid particle as measured by the tortuosity is different for each process. The results of these simulations are consistent with the "equivalent channel model," which shows that by introducing the tortuosity of the fluid flow or electric current paths, one can relate the microscopic physics of the transport properties to the macroscopic behaviors described by Darcy's and Ohm's laws. © American Geophysical Union 1989

5804 Geochemistry

Refer also to citation(s) 41582, 42628

43703 Regional trends in the oxygen isotopic compositions of granitoid plutons, central and southern Appalachians. Wesolowski, D. (Oak Ridge National Laboratory, TN (USA)); Sans, J.R.; Thornton, C.P.; Ohmoto, H. *Geological Society of America, Abstracts with Programs (USA)*, 17: 748 (1985). (CONF-8510489–: 98. annual meeting of the Geological Society of America, Orlando, FL (USA), 28-31 Oct 1985).

Whole-rock oxygen isotope analyses of 125 samples from 87 plutons, together with average values from 20 additional plutons reported by Wenner (1981) and Casadevall and Rye (1980), representing nearly every major post-Grenville pluton of the crystalline Appalachians of Maryland-Alabama, are summarized. The high-^{18}O granitoids of the Blue Ridge, Ashland-Wedowee, and Inner Piedmont belts are indicative of source regions with a substantial metasedimentary component. The absence of high-^{18}O granitoids in the Slate Belt throughout its Precambrian-Hercynian intrusive history suggests an oceanic crust beneath this terrane, although meteoric water-rock interaction may have affected many of these plutons. The Charlotte and Raleigh belts contain plutons with $\delta^{18}O_{wr}$ ranges intermediate between these two extremes. High-^{18}O Hercynian plutons of the Kiokee (Clouds Creek, Edgefield) and "?" belts (terrane east of the Raleigh and north of the Eastern Slate Belt containing the Petersburg, Fallmouth and Gunpowder intrusives) suggest a significant metasedimentary component in the source regions of the youngest and eastern most of the Southern Appalachian intrusives.

43704 Stable isotope and fluid inclusion studies of metamorphic fluid flow in an evolving tectonic system. Wesolowski, D. (Oak Ridge National Laboratory, TN (USA)); Cole, D.R.; Drummond, M.S.; Stakes, D.R. *Geological Society of America, Abstracts with Programs (USA)*, 17: 748 (1985). (CONF-8510489–: 98. annual meeting of the Geological Society of America, Orlando, FL (USA), 28-31 Oct 1985).

The Southern Appalachian borehole represents a unique opportunity to couple O-H-C-S isotope and fluid inclusion studies with textures, mineralogies, and chemical compositions in order to assess the role of fluids in metamorphism, deformation, element migration, and heat transfer throughout the evolution of a complex orogen. Studies which focus on hydrothermal veins, felsic/mafic intrusives and juxtaposed but chemically and isotopically distinct lithologies such as volcanics/-clastics and silicates/carbonates will be particularly informative. That large-scale metamorphic fluid flow has occurred in the Southern Appalachians is evidenced by devolatilization of enormous masses of rock during prograde metamorphism and extensive revolatilization, along major shear zones exhibiting retrograde assemblages. The authors own textural, chemical and oxygen isotope studies of granitoids and their host rocks in Northern Alabama document substantial isotopic, major and trace element (e.g. U, Th, Pb, Rb, and Sr) redistribution over thousands of cubic kilometers via exchange with infiltrating metamorphic fluids. Even chemically and mineralogically unaltered granites in the area have been isotopically enriched, perhaps reflecting differing chemical and isotopic exchange capacities of the fluid/rock system. These observations suggest that the chemical and isotopic effects of metamorphic fluid flow must be quantified in order to determine the origins of sedimentary and igneous rocks based on their geochemical signatures and age dates and to evaluate the role of fluids in the tectonic evolution of the proposed study area.

5805 Oceanography

Refer also to citation(s) 43038

64 PHYSICS I

Refer also to citation(s) 42242

43705 (INIS-SU–96) **General and nuclear physics. Scientific-technical collection of papers.** Boldyshev, V.F. (ed.). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 138p. (In Russian). Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

Individual papers in this collection are separately indexed.

43706 (INIS-SU–102) **Experimental and theoretical physics. Collection.** Kratkie soobshcheniya po fizike. No. 9. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. 65p. (In Russian). Order Number DE89012199/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Individual papers in this collection are separately indexed.

43707 (INIS-SU–109/A) **Experimental and theoretical physics.** Kratkie soobshcheniya po fizike. No. 10. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. 61p. (In Russian). Order Number DE89012198/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Individual papers in this collection are separately indexed.

6401 Astrophysics and Cosmology

Refer also to citation(s) 43735, 43737, 43772

43708 (AD-A–205324/7/XAB) **Extended solar-activity cycle.** Wilson, P.R.; Altrock, R.C.; Harvey, K.L.; Martin, S.F.; Snodgrass, H.B. Air Force Geophysics Lab., Hanscom AFB, MA (USA). 23 Jun 1988. 4p. (AFGL-TR–89-0047). Available from NTIS, PC A02/MF A01.

Pub. in Letters to Nature, Vol. 333, 748-750(23 Jun 1988).

The solar cycle has been defined in terms of a sequential periodic variation in sunspot numbers, the period being the interval between successive minima, currently averaging 11.2 years. But a number of observations have indicated that the activity cycle may begin at higher latitudes before the emergence of the first sunspots of the new cycle. Here results are reported from sunspot cycle 21 concerning the ephemeral active regions, the coronal green-line emission and the torsional oscillation signal, which confirm the earlier suggestions. The appearance of a high-latitude population of ephemeral active regions in the declining phases of sunspot cycle 21, is reported with orientations that tend to favor those for cycle 22 rather than 21. Taken together, these data indicate that sunspot activity is simply the main phase of a more-extended cycle that begins at high latitudes before the maximum of a given sunspot cycle and progresses towards the equator during the next 18-22 yr, merging with the conventional 'butterfly diagram' (the plot of the latitudes of emerging sunspots against time) as it enters sunspot latitudes. This extended cycle may be understood in the perspective of a model of giant convective rolls that generate dynamo waves propagating from pole to equator.

43709 (AD-A–205326/2/XAB) **Image processing of coronal pictures.** Smartt, R.N.; Koutchmy, O.; Koutchmy, S.; Nitschelm, C.; Sykora, J. Air Force Geophysics Lab., Hanscom AFB, MA (USA). 28 Feb 1989. 13p. (AFGL-TR–89-0060). Available from NTIS, PC A03/MF A01.

Coronal images contain many complex, superposed, faint, optically-thin structures: Rays, loops, curved streamers, etc. The spatial resolution is often limited by the signal/noise ratio in the recording medium while the dynamic range in intensity is severely dominated by the radial gradient. The results obtained with a new simple image-processing algorithm are applied to several typical eclipse and coronographic pictures. This 2D filter (second-order difference operator in k-direction) shows superior quality by improving the signal/noise ratio, reducing the dynamic range and enhancing faint coronal structures. A comparison with results obtained with more commonly used 2D filters is also presented. The algorithm used here are briefly described, together with discussions of enhanced coronal images of coronal physics interest.

43710 (AD-A-205384/1/XAB) **Effects of acoustic and gravity waves on the curve of growth.** Marmolino, G. Air Force Geophysics Lab., Hanscom AFB, MA (USA). 1987. 16p. (AFGL-TR-89-0053). Available from NTIS, PC A03/MF A01.

Pub. in Solar Physics, Vol. 112, 211-226(1987).

Unresolved motions, or microturbulence, play a very important role in determining the Doppler width of the line-absorption coefficient. The concept of microturbulence was introduced because observed solar and stellar lines are broader than is explicable within the framework of other line broadening mechanisms. By constructing a curve-of-growth in the presence of a dynamical model for simple acoustic and gravity waves, this paper evaluates the errors introduced by the use of kinematic models for line-broadening (microturbulence) into determinations of non-thermal velocity fields and element abundances. Distinct differences between gravity and acoustic waves are apparent in the trend of the line asymmetry with the excitation potential as well as in the magnitude of the errors introduced by the temperature and pressure variations associated with the velocity field.

43711 (AD-A-205538/2/XAB) **Small-scale coronal structures.** Koutchmy, S.L. Air Force Geophysics Lab., Hanscom AFB, MA (USA). 1988. 29p. (AFGL-TR-89-0056). Available from NTIS, PC A03/MF A01.

Pub. in Solar and Stellar Coronal Structure and Dynamics: A Festschrift in Honor of Dr. John W. Evans, 208-235(1988).

A few problems connected with the observation and analysis of fine-scale coronal density structures are reviewed. The inner corona and middle corona are considered. The relations existing between the coronal magnetic fields and coronal dynamics at small scale are emphasized, including impulsive events.

43712 (AD-A-205649/7/XAB) **Study of the infrared celestial background. Final report, 1 February 1985-31 January 1988.** Bentley, A.F. Eastern Montana Coll., Billings, MT (USA). Dept. of Physical Sciences. 30 Sep 1988. 67p. Available from NTIS, PC A04/MF A01.

The following revised objectives were formulated: to determine the nature of infrared sources observed; to carry out theoretical investigations on the nature and evolution of selected infrared sources; and to establish the statistical distribution of infrared-sources in space to a sensitivity limit and spatial resolution consistent with available observing equipment and techniques. Research on infrared sources in the W40 complex was published. Results of radio and infrared observations of OH/IR stars in the Galaxy were published. A theoretical study of the possibilities for observation of galaxies in the process of formation in the early universe was published in the Proceedings of the Montana Academy of Science. The results of a series of observations made on Nova Vulpeculae 1984 2 were published. Preliminary results on studies of the infrared properties of the nuclei of planetary nebulae were presented. A theoretical model was constructed for transfer of cosmic ray energy to emission nebulae.

43713 (AD-A-205762/8/XAB) **Stellar activity and the rotation of Hyades stars.** Radick, R.R.; Baliunas, S.L. Air Force Geophysics Lab., Hanscom AFB, MA (USA). Dec 1987. 4p. (AFGL-TR-89-0049). Available from NTIS, PC A02/MF A01.

Pub. in Cool Stars, Stellar Systems and the Sun V, Vol. 291, 217-219(Dec 198).

New measurements of rotation periods for Hyades stars, which were obtained from re-analysis of Mount Wilson Observatory Ca II H-K emission flux measurements, are reported. The existence of systematic, color-dependent discrepancies between the measured rotation periods for Hyades stars and those predicted by the Rossby relation as originally calibrated by Noyes et al. 1984 has led to a re-examination of the form of the relationship between chromospheric emission, rotation, and color.

43714 (AD-A-205763/6/XAB) **Broadening and shift of Fe I lines perturbed by atomic hydrogen.** Gomez, M.T.; Marmolino, C.; Roberti, R.; Severino, G. Air Force Geophysics Lab., Hanscom AFB, MA (USA). 1987. 8p. (AFGL-TR-89-0051). Available from NTIS, PC A02/MF A01.

Pub. in Solar Physics, Vol. 112, 227-232(1987).

The broadening and shift parameters for a number of Fe I lines perturbed by atomic hydrogen are computed using the interatomic potential due to Hindmarsh et al (1967, 1970). It is also shown that the rms radius and the effective radius of the radiating atom, which determine the force constants in the interatomic potential, can be simply related to each other depending on the orbital quantum number of the atomic level.

43715 (AD-A-205764/4/XAB) **Rotation characteristics of the Fe XIV (5303 A) solar corona.** Sime, D.G.; Fisher, R.R.; Altrock, R.C. Air Force Geophysics Lab., Hanscom AFB, MA (USA). 1 Jan 1989. 16p. (AFGL-TR-89-0052). Available from NTIS, PC A03/MF A01.

Pub. in Astrophysical Jnl. Vol. 336, 454-467(1 Jan 1989).

Synoptic photoelectric observations of the coronal Fe XIV line at 5303 A were analyzed to reveal the rotational behavior of the solar corona as detected in that line. A correlation analysis shows that the average synodic rotation period for a band from 30N to 30S was 27.52 days. Although the lifetimes for features in the Fe XIV corona are slightly less than those for the electron corona, overall, their rotation properties are more similar to the white-light corona than to those of active regions on the Sun with which they are generally thought to be associated. However, there appears to be a significant and time-varying component which shows differential rotation. This component appears during cycle 21 at high 7 or 60° latitudes in the late ascending phase and moves toward the equator. As the cycle progresses, the component becomes indistinguishable from faster rotating features near the equator and the effect is to produce a net differential rotation intermediate between that of the photosphere and that of the white-light corona. The observations appear to be consistent with the interpretation that the Fe XIV coronal signal arises from the effects of local heating on the large-scale density structure of the corona.

43716 (AD-A-205765/1/XAB) **Solar-cycle variations of coronal neutral lines and polar regions activity.** Makarov, V.I.; Makarova, V.V.; Koutchmy, S.; Sivaraman, K.R. Air Force Geophysics Lab., Hanscom AFB, MA (USA). 1988. 16p. (AFGL-TR-89-0059). Available from NTIS, PC A03/MF A01.

Pub. in Solar and Stellar Coronal Structure and Dynamics: A Festschrift in Honor of Dr. John W. Evans, 362-375(1988).

Observations of the corona, of prominences, of polar faculae and of large scale magnetic fields show solar activity over all latitudes, in contrast with sunspot activity, which is limited to mid-latitudes. The global behavior of the solar activity is considered here thanks to the analysis of chromospheric synoptic maps which include the location of Hα and Ca II k prominences. The process of migration of neutral lines during the cycle (supposed to represent the large-scale coronal magnetic field) is shown. After subsequent averaging of the maps, a discrete number of latitude zones is found: not more than 10, the most probable number being 3 or 5. This suggests the occurrence of dominant modes (1=3 and 1=5) of the large-scale coronal magnetic field and inferred coronal structures for different epochs of the solar cycle. The geoactivity of coronal streamers could be related to the modes, noticing the dipole (1=1) mode is almost absent. A more-detailed analysis points to the importance of the poleward migration of neutral lines (with v = 5 to 40 micro sec-1). The nonsymmetric behavior of the N and S hemisphere as well as the erratic behavior of the corresponding sunspot activity in each hemisphere is emphasized, which reflects the behavior of both the radial component and the toroidal component of the field.

43717 (AD-A-205766/9/XAB) **Solar emission-line corona: current and future ground-based observational research.** Altrock, R.C. Air Force Geophysics Lab., Hanscom AFB, MA (USA). 1988. 5p. (AFGL-TR-89-0057). Available from NTIS, PC A02/MF A01.

Pub. in Solar and Stellar Coronal Structure and Dynamics: A Festschrift in Honor of Dr. John W. Evans, 288-291(1988).

This is a review of the status of ground-based solar coronal research that took place during the Workshop on Solar and Stellar Coronal Structure and Dynamics. Topics of discussion included current observational capabilities, research problems suitable for attack now and in the future, and possible future instrumentation, including the Advanced Reflecting Coronagraph.

43718 (AD-A-205767/7/XAB) **Variation of solar coronal Fe XIV 5303 A emission during solar cycle 21.** Altrock, R.C. Air Force Geophysics Lab., Hanscom AFB, MA (USA). 1988. 9p. (AFGL-TR-89-0058). Available from NTIS, PC A02/MF A01.

Pub. in Solar and Stellar Coronal Structure and Dynamics: A Festschrift in Honor of Dr. John W. Evans, 414-420(1988).

Investigation of the behavior of coronal intensity above the limb in Fe XIV emission (5303 A) obtained at Sacramento Peak Observatory over the last fourteen years resulted in the confirmation of a second set of zones of solar activity at high latitudes separate from the Main Activity Zones (MAZ). Localized emission peaks in Fe XIV 5303 A are observed through most of the cycle at latitudes in individual daily scans, annual averages, and solar-cycle summary plots of the location of all local maximum intensities at 0.15R above the limb. These peaks evolve slowly over a period of days, consistent with the rotation over the limb of stable features, in a similar way to the lower-latitude peaks connected with active regions. The high-latitude coronal-activity zones first appear at latitudes of 70 to 80 deg, 2-3 years after solar minimum. They evolve approximately parallel to the MAZ, with the average latitude decreasing at rate of roughly 5-6 deg per year. After their appearance, they are present more or less continuously until the following solar minimum. Near solar minimum, the high-latitude coronal activity zones that appeared after the beginning of Cycle 21 monotonically evolved into the MAZ of Cycle 22. It thus appears that we have evidence for parallel overlapping solar cycles that begin every 11 years but last for approximately 19-20 years.

43719 (AD-A-206052/3/XAB) **Geomagnetic disturbances. Final report, 1 October 1985-30 September 1988.** Scherrer, P.H. Stanford Univ., CA (USA). Center for Space Science and Astrophysics. Jan 1989. 32p. Available from NTIS, PC A03/MF A01.

Investigations included observations and analysis of the solar and interplanetary quantities relevant to geomagnetic activity. The operation of the Wilcox Solar Observatory and analysis of the synoptic observations of magnetic fields has constituted a significant part of the effort. Emphasis has been to attempt to understand the timing and severity of geomagnetic disturbances by understanding the solar mechanisms responsible for the origin of solar wind variations.

43720 (AD-A-206335/2/XAB) **Ground-based infrared observations of sources discovered by the AFGL, FIRRSE and IRAS infrared surveys. Final report, 15 July 1984-14 July 1987.** Spillar, E.J. Wyoming Univ., Laramie, WY (USA). Dept. of Physics and Astronomy. 30 Jun 1988. 4p. Available from NTIS, PC A02/MF A01.

The contracts research objective was to understand the infrared sources discovered by the AFGL, FIRRSE and IRAS Infrared Surveys. Work has continued on young stellar objects with a variety of collaborators. In particular, extensive infrared and radio observations have yielded new information on the true nature of this highly energetic outflow object. Particular results are the lack of a disk and the resolution of accelerated shells. High-resolution maps have been made of several other young stellar objects in an effort to understand the energetics and nature of the objects. The group has continued its investigation of comets. Comets investigated include Giacobini-Zinner and Halley. Emphasis has been on understanding the emission from the dust in these objects. Because of the changing illumination of these dust grains, and the well understood geometry of comets, these objects provide unique information on interstellar dust.

43721 (AD-A-206666/0/XAB) **Evolution of solar magnetic flux.** Boris, J.P.; DeVore, C.R.; Golub, L.; Howard, R.F.; Howard, R.H. Air Force Geophysics Lab., Hanscom AFB, MA (USA). Feb 1989. 5p. (AFGL-TR-89-0055). Available from NTIS, PC A02/MF A01.

Pub. in Solar Terrestrial Physics: Present and Future, 33-34(Feb 1989).

This review concentrates on what can be deduced from observations by addressing four question that shape the discussion. (1) How does flux emerge on the Sun. (2) How does magnetic flux disappear. (3) What is seen at the limits of resolution. (4) What large-scale patterns are detected. The answer to the fundamental question, How the solar dynamo works, can only evolve from interpreting clues uncovered in research aimed at illuminating various aspects of these more 'visible' questions.

43722 (DOE/ER/40317-T1) **Research in nuclear astrophysics: Stellar collapse and supernovae, progress report.** Lattimer, J.M.; Yahil, A. State Univ. of New York, Stony Brook, NY (USA). [1989]. 28p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER40317. Order Number DE89016630/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The interaction between nuclear theory and some outstanding problems in astrophysics is examined. We are actively researching both the astrophysics of gravitational collapse, neutron star birth, and the emission of neutrinos from supernovae, on the one hand, and the nuclear physics of the equation of state of hot, dense matter on the other hand. There is close coupling between nuclear theory and the supernova phenomenon; in fact, nuclear matter properties, especially at supernuclear densities, might be best delineated by astrophysical considerations. Our research has also focused on the neutrinos emitted from supernovae, since they are the only available observables of the internal supernova mechanism. The recent observations of neutrinos from SN 1987A proved to be in remarkable agreement with models we pioneered in the one and one half years prior to its explosion in February 1987. We have also developed a novel hydrodynamical code in which shocks are treated via Riemann resolution rather than with artificial viscosity. We propose to modify it to use implicit differencing and to include multi-group neutrino diffusion and General Relativity. In parallel, we are extending calculations of the birth of a neutron star to include convection and mass accretion, by incorporating a hydrodynamic envelope onto a hydrostatic core. In view of the possible recent discovery of a pulsar in SN1987A, we are including the effects of rotation. We are undertaking a detailed comparison of current equations of state, focusing on disagreements regarding the nuclear incompressibly, symmetry energy and specific heat. Especially important is the symmetry energy, which below nuclear density controls free proton fractions and weak interaction rates and above this density critically influences the neutron star maximum mass and binding energy. 60 refs.

43723 (ENEA-RT-TIB-88-23) **Proposal of comparative Maunder minimum cosmogenic isotope measurements.** Attolini, M.R.; Nanni, T.; Galli, M.; Salomoni, A.; Povinec, P. ENEA, Rome (Italy). 1989. 9p. Order Number DE89634521/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

There are at present contraddictory conclusions about solar activity and cosmogenic isotope production variation during Maunder Minimum. The interaction of solar wind with galactic cosmic rays, the dynamic behaviour of the Sun either as a system having an internal clock, and/or as a forced non linear system, are important aspects that can shed new light on solar physics, the Earth-Sun relationship and the climatic variation. An essential progress in the matter might be made by clarifying the cosmogenic isotope production during the mentioned interval. As it seems that during Maunder Minimum the Be10 production oscillates of about a factor of two, the authors have also to expect short scale enhanced variations in tree rings radiocarbon concentrations for the same interval. It is therefore highly desirable that for the same interval, that the authors would identify with 1640-1720 AD, detailed concentration measurements both of Be10 (in dated polar ice in addition to those of Beer et al.) and of tree ring radiocarbon, be made with cross-checking, in samples of different latitudes, longitudes and within short and large distance of the sea. The samples could be taken, as for example in

samples from the central Mediterranean region, in the Baltic region and in other sites from central Europe and Asia.

43724 (INIS-SU–109/A, pp. 56-58) **Diffusion gamma radiation of the Galaxy in the energy range of $10^{10}<E\leq5x10^{14}$ eV.** Urysov, A.V. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics.* Order Number DE89012198/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 10.

Spectrum of gamma-quantum birth in π^0-meson decay in the energy range $E>10^{10}$ eV was obatined. Spectra of gamma raiation of galactic disk in directions to the center and anticenter at energies of $10^{10}<E\leq5x10^{14}$ eV were calculated. Correlation with gamma-data, obtained by using devices for investigation of wide atmospher showers was conducted. 11 refs.; 1 tab.

43725 (INS–740) **Double compactification.** Nakamura, A.; Shiraishi, K. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Mar 1989. 27p. Order Number DE89906506/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A cosmological scenario that our universe experienced space-time compactifications twice in its early development is investigated through toy models. In this scenario gauge configurations on an extra space play essential roles to bring about a change of the dimensionality of the compactified space. Simple models are offered and their behavior at finite temperature is examined. A possibility of causing inflation and problems on our scenario is argued briefly. (author).

43726 (LA-UR–89-2384) **Continuum spectra for gamma-ray bursts: Suppressing the soft photons.** Ho, Cheng; Epstein, R.I. Los Alamos National Lab., NM (USA). 1989. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8904216–5: Gamma ray observatory science workshop, 10-12 Apr 1989). Order Number DE89015260/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Gamma-ray bursts are observed to have very steep spectra below photon energy ~100 keV; some have photon number spectra as steep as $F \propto E^0$. This property has been difficult to explain in terms of most radiation processes. The BATSE experiment on the Gamma Ray Observatory should be able to test how common this spectral property is and whether there are bursts with even steeper low-energy spectra. To explain this spectral steepness, we study a model in which the γ radiation is produced by inverse-Compton and cyclotron scattering of blackbody radiation from the surface of a neutron star by relativistic electrons. If the neutron star has negligible magnetic field, Compton scattering dominates in producing the observed gamma-ray burst spectra. If the field exceeds 10^{10} G, cyclotron scattering is more important. In the low-magnetic-field case, steep spectra may be produced via the suppression of the low energy part of the "cooling spectrum" (the spectrum integrated over the radiation lifetime of an electron), as a result of the smaller and more collimated photon flux an electron sees as it moves away from the neutron star. In the high-magnetic-field case, low-energy suppression occurs because electrons with higher energies scatter the blackbody photons more efficiently due to the cyclotron resonance, preferentially producing high energy photons. 27 refs., 5 figs.

43727 (LA-UR–89-2422) **The EUV emission of cataclysmic variables.** Raymond, J.C.; Mauche, C.W. Los Alamos National Lab., NM (USA). Jul 1989. 11p. Sponsored by DOE/DP;NASA. DOE Contract W-7405-ENG-36. (CONF-890189–7: Berkeley colloquium on extreme ultraviolet astronomy, 19-20 Jan 1989). Order Number DE89015254/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Approximately half the luminosity of a typical cataclysmic variable may emerge as an optically thick component peaking in the EUV. Observations of this component are important for understanding the energetics and accretion rates of CV's in general, as well as for understanding the physics of the accretion process. The nature of the turbulent boundary layers and winds of disk accretors and the heating of the white dwarfs by accretion are among the problems which can be addressed by observations in the EUV. 46 refs., 2 figs.

43728 (LBL–27392) **The interplay of nuclear and atomic physics in the synthesis of the elements.** Norman, E.B. Lawrence Berkeley Lab., CA (USA). Mar 1989. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890387–7: Workshop on highly charged ions: new physics and advanced techniques, 13-15 Mar 1989). Order Number DE89016305/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In many astronomical environments, physical conditions are so extreme that matter is almost completely ionized. The absence of bound atomic electrons can dramatically alter the decay rates of a number of radioactive nuclei. Several examples of this interplay of nuclear and atomic physics relevant to the synthesis of the chemical elements are described. 16 refs., 4 figs.

43729 (PB–89-170039/XAB) **Black holes in closed universes.** Qadir, A. Quaid-i-Azam Univ., Islamabad (Pakistan). Dept. of Mathematics. Aug 1988. 35p. (QAUM–88/36). Available from NTIS, PC EE03/MF A01.

Black holes are usually defined in the context of asymptotically flat space-times. In order to demonstrate that the black hole and big-crunch singularities are essentially part and parcel of the same singularity, cut-and-paste methods were used to construct models in which the black hole was embedded in a closed cosmology. In this paper the variation of the properties of the model with initial conditions is investigated. The problem, that there is no longer an 'observer at infinity' (as a ready reference to define the black hole), is overcome by using a foliation of constant mean extrinsic curvature to define the 'preferred observer' at every point.

43730 (PB–89-173058/XAB) **Solar-Geophysical Data Number 534, February 1989. Part 2 (comprehensive reports). Data for August 1988 and miscellaneous.** Coffey, H.E. National Geophysical Data Center, Boulder, CO (USA). Feb 1989. 68p. (SGD–534-PT-2). Available from NTIS, PC A04/MF A01.

See also Part 1, PB–89-173041.

Contents include: detailed index for 1988 and 1989; data for August 1988 (solar flares, solar radio bursts at fixed frequencies, solar x-ray radiation from goes satellite, mass ejections from the sun, active prominences and filaments); miscellaneous data (Meudon carte synoptique July 1988).

43731 (PB–89-184949/XAB) **Molecular cloud content of early-type galaxies. 1. Detections and global properties.** Wiklind, T.; Henkel, C. Chalmers Univ. of Tech., Goeteborg (Sweden). Onsala Space Observatory. 1989. 25p. (REPT–89/01). Available from NTIS, PC EE02/MF A01.

The authors have started an observing program to detect and map the molecular gas in elliptical and lenticular galaxies using the CO(1-0) and (2-1) emission lines as tracers of the gas. The galaxies they have observed to date constitute a sample selected through their far-IR properties and the presence of dust only. Remarkably enough, the detection rate has been very high, approaching 100% if one excludes those with upper limits too large to be significant when compared with the levels of the detected ones. The authors present the observations and a discussion of the global properties of the molecular content of early-type galaxies compared with a sample of spiral galaxies compiled from the literature.

43732 **Phenomenology and cosmology with superstring-motivated models.** Shafi, Q. (Bartol Research Foundation, Univ. of Delaware, Newark, DE (US)). vp. of Superstrings, anomalies and unification. Martinis, M.; Andric, I. World Scientific Pub. Co., Teaneck, NJ (1987). (CONF-8606383–: 5. Adriatic meeting on particle physics, Dubrovnik (Yugoslavia), 16-28 Jun 1986).

The authors discuss how realistic low-energy physics can arise from the E_8xE_8 superstring. A key role is played by the discrete symmetries which typically arise after compactification. Cosmological problems are avoided because the discrete symmetry the authors employ is shown to be effectively embedded in a Peccei-Quinn symmetry. The models they present seem to satisfy the known phenomenological and cosmological constraints. In particular, they possess a harmless axion. The existence of topologically stable superconducting vortices (strings), surviving until today, is predicted. Other topics that are discussed include the proton decay, the baryon asymmetry in the Universe and n-n-bar oscillations.

43733 Cosmologically benign gravitinos at the weak scale. Frieman, J.A. (Fermi National Accelerator Lab., Batavia, IL (USA)); Guidice, G.F. *Physics Letters [Section] B (Netherlands)*, 224(1/2): 125-130 (23 Jun 1989).

We show that a gravitino with mass $O(m_W)$ and a high reheat temperature after inflation, $T_R \simeq 10^{12}$-10^{14} GeV, can be compatible with cosmological constraints if the gravitino decays predominantly into neutrino-sneutrino pairs. Models in which the lightest supersymmetric particle is either the sneutrino or the neutralino are described. In this scenario, gravitino decay provides an alternative mechanism for producing supersymmetric dark matter, which may be either hot or cold. (orig.).

43734 Search for the decay $D^0 \rightarrow \bar{K}^0 e^+ e^-$. Adler, J. (University of Washington, Seattle, Washington 98195(US)); Becker, J. J.; Blaylock, G. T.; Bolton, T.; Brient, J. C.; Brown, J. S.; Bunnell, K. O.; Burchell, M.; Burnett, T. H.; Cassell, R. E.; and others. *Physical Review [Section] D: Particles and Fields (USA)*, 40(3): 906-908 (1 Aug 1989). DOE Contract AC02-76ER01195.

A search for the decay of the charmed meson $D^0 \rightarrow \bar{K}^0 e^+ e^-$ is presented, based on data collected at the $\psi(3770)$ resonance with the Mark III detector at the SLAC storage ring SPEAR. No evidence for this process is found, resulting in an upper limit on the decay branching ratio of 1.7×10^{-3} at the 90% confidence level.

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Refer also to citation(s) 43719

43735 (AD-A–205432/8/XAB) **Optical studies of the magnetospheric cusp from svalbard. Technical report, 30 September 1987-29 September 1988.** Henriksen, K. Tromsoe Univ. (Norway). Auroral Observatory. 2 Jan 1989. 5p. Available from NTIS, PC A02/MF A01.

This investigation was made on spectrometric auroral data obtained on the dayside and nightside of the auroral oval in Svalbard. Synthetic spectra of O_2^+ 1NG and N_2^+ 1NG bands were calculated. The transition probabilities were obtained by particular solutions of the Schroedinger equation. The synthetic spectra were used to analyze the auroral spectrum from 5200 to 5800 A, deriving the intensities of all the auroral emissions of this spectral region. The same spectral technique was used to analyze solar spectra, deriving ozone column densities and spectral UV irradiances.

43736 (AD-A–205461/7/XAB) **User's guide to RAYTRACE. Memorandum report, October 1987-April 1988.** Reilly, M.H.; Strobel, E.L. Naval Research Lab., Washington, DC (USA). 8 Feb 1989. 296p. (NRL-MR–6377). Available from NTIS, PC A13/MF A01.

Availability: Document partially illegible.

Operation of the RAYTRACE (version 4.3) software for ionospheric ray tracing is explained. First, installation and setup of the program are discussed. Instructions for routine operation are given, followed by several tutorial examples. Some suggestions for regular usage are given. The final section and the appendices contain useful material, including the source code listing. The RAYTRACE computer program has a number of distinctive capabilities. It performs fully three-dimensional HF/VHF ray tracing through a climatological ionosphere. Single or multiple rays may be traced during a single run, allowing the user greater flexibility in modeling. The size of the increments used in the ray path calculation is user adjustable so that appropriate compromises may be made between execution time and accuracy. The program can trace rays between points at different altitudes. Cutoff criteria may be set to stop the calculation at a particular range or altitude. RAYTRACE calculates a number of important quantities about the ray. The change in signal intensity due to distance and ionospheric focusing or defocusing is calculated. The group and phase path length values are both calculated. The location, as well as information on the direction of the ray, are calculated for the end point of the ray and any intervening earth impact points (collectively these are called the data points for the ray).

43737 (AD-A–205599/4/XAB) **Solar flares and magnetospheric particles: investigations based upon the ONR-602 and ONR-604 experiments. Annual letter report for period ending 30 November 1988.** Wefel, J.P. Louisiana State Univ., Baton Rouge, LA (USA). Dept. of Physics and Astronomy. 30 Nov 1988. 49p. Available from NTIS, PC A03/MF A01.

Data from the ONR-602 experiment, obtained in a low-altitude, polar orbit are being analyzed to investigate the composition, intensity levels and time variations of energetic charged particles both trapped within the Earth's magnetosphere and incident upon the magnetosphere from interplanetary space, particularly solar-flare particles. The effort involves both data analysis/interpretation and detailed modeling of the near-Earth environment. The research focusses on the 'global zones' of low-energy particle precipitation, including the South Atlantic Anomaly region from which access to the radiation belts is obtained, and the solar particle events of May-Nov., 1982. In addition, scientific/technical support is being provided to the ONR-604 experiment to be launched on the CRRES mission. The results of these investigations will enhance our understanding of the geospace radiation environment and its effects on men, materials, and electronic systems in space.

43738 (AD-A–205703/2/XAB) **Polar-cap plasma convection measurements and their relevance to the real-time modeling of the high-latitude ionosphere.** Air Force Geophysics Lab., Hanscom AFB, MA (USA). 7 May 1987. 18p. (AFGL-TR–88-0253). Available from NTIS, PC A03/MF A01.

Pub. in The Effect of the Ionosphere on Communication, Navigation, and Surveillance Systems Based on Ionospheric Effects Symposium, 659-673(5-7 May 1987).

Plasma-convection measurements, using Digisonde ionospheric sounders, were conducted. The plasma convection or ionospheric-drift measurements conducted at Thule and Qaanaaq during campaigns from Winter 1983/84 to present provide evidence, that antisunward convection dominates in the polar cap with velocities typical between 300 and 900 m.sec. Drift shears were observed during periods of arc-transition (quiet magnetic conditions). Observations of the plasma drift at Goose Bay show a drift reversal from westward to eastward around midnight CGLT. Observations at Argentia, typically a suboval/trough station, provide evidence under magnetically disturbed conditions for the midnight reversal of the antisunward flow pattern. However, the data are less consistent under magnetically quiet conditions. The proximity of the station to the boundary between corotating and convecting plasma may at times affect the consistency of the measurements. Recent theoretical calculations of electron density profiles within the high-latitude/polar-cap ionosphere demonstrate that the diurnal foF2 variation observed at Thule, is controlled by the plasma-convections pattern and the associated drift velocities. The model calculations for Bz < 0 and Bz. approx. 0 show factor 2 to 3 differences in Nmax over Thule, supporting the stated importance of convection pattern and velocity measurements for the modelling of the high-latitude ionosphere.

43739 (AD-A–205965/7/XAB) **Impact of the geoplasma on a spaceborne GPS (global positioning system) receiver system - a preliminary study. Memorandum report.** Goodman, J.M. Naval Research Lab., Washington, DC (USA). 28 Feb 1989. 151p. (NRL-MR–6290). Available from NTIS, PC A08/MF A01.

It is well known that the most-accurate positioning information obtainable from the GPS system, in the traditional application where the receivers are located on or very near to the surface of the earth, i.e., beneath the ionosphere, is achieved through use of the two-frequency method so that the ionospheric component of the ranging error can be removed. However, in an application where a GPS receiver is itself located on a spacecraft orbiting above some of the electron content in the ionosphere and protonosphere, the question as to whether a two-frequency system is necessary may have a different answer. In this preliminary study, the parameters of the latter question are explained and the range of errors which might be experienced by a single-frequency system are estimated.

43740 (AD-A–205976/4/XAB) **VLF/LF (very low frequency/low frequency) reflection properties of the low-latitude ionosphere. Interim technical report.** Klemetti, W.I.; Kossey, P.A.; Rasmussen, J.E.; Sueli Da Silveira Macedo Moura, M. Air Force Geophysics Lab., Hanscom AFB, MA (USA). 4 Feb 1988. 95p. (AFGL-TR–88-0034). Available from NTIS, PC A05/MF A01.

Low-latitude observations of VLF/LF pulse reflections from the lower ionosphere obtained at nine locations to the east and west of a transmitter in southeastern Brazil are described. The data provide

a variety of information on the reflection properties of the ionosphere below about 90-km altitude. Aspects of the data are presented in quasi-dimensional formats useful for identifying ionosphere structure and variability, and detailed analyses of portions of the data provided, which characterize the effective heights of the reflection coefficients of the ionosphere at noon and midnight, over a frequency range from 15 to 65 kHz. Electron-density models of the ionosphere, derived from VLF/LF reflection data are also discussed.

43741 (AD-A-206062/2/XAB) **Plasma simulation of ion acceleration by lower hybrid waves in the suprauroral region.** Retterer, J.M.; Chang, T.; Jasperse, J.R. Air Force Geophysics Lab., Hanscom AFB, MA (USA). 27 Sep 1988. 5p. (AFGL-TR-88-0250). Available from NTIS, PC A02/MF A01.

Pub. in Ion Acceleration in the Magnetosphere and Ionosphere, 282-285(1986).

The generation of lower hybrid waves below field-aligned potential drops and the effect of the resulting turbulence on the ion population in the suprauroral region are studied using particle plasma simulations. To describe the ion acceleration observed in the simulation, a theoretical model is developed using mode-mode coupling processes to generate the low phase velocity VLF waves with which the ions first interact. By scaling the simulation results, we show that interaction between the ions and the lower hybrid waves can account for the acceleration necessary to produce suprauroral ion conic events.

43742 (AD-A-206227/1/XAB) **X-ray spectrophotometric remote sensing of diffuse auroral ionization. Technical report.** Vondrak, R.R.; Robinson, R.M.; Mizera, P.F.; Gorney, D.J. Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab. 20 Mar 1989. 24p. (TR-0088(3940-06)-3). Available from NTIS, PC A03/MF A01.

Auroral electron precipitation produces both E-region ionization and bremsstrahlung x rays. In a set of coordinated observations these atmospheric effects of electron precipitation were measured simultaneously by the x-ray sensor on the DMSP/F2 spacecraft and by the incoherent-scatter radar at Chatanika, Alaska. In all data sets there was good agreement between the locations of the x-ray source regions and the regions of enhanced E-region ionization. Detailed comparisons were made between the measured and derived altitude profiles of ionization for two auroral conditions, a pre-midnight auroral band and a sunlit diffuse aurora. These comparisons validate the ability to derive auroral ionization from satellite-based x-ray measurements.

43743 (AD-A-206252/9/XAB) **Particle simulations of magnetospheric plasmas. Final report, 1 November 1987-31 October 1988.** Nishikawa, K.I. Iowa Univ., Iowa City, IA (USA). Dept. of Physics and Astronomy. 14 Mar 1989. 11p. Available from NTIS, PC A03/MF A01.

Plasma-physics processes occurring in magnetospheric plasmas are studied by means of numerical simulations. This study has included the excitation of instabilities due to electron currents and/or ion beams due to the presence of nonuniform electric fields. The investigations also included the heating and transport of plasma in the presence of particle interactions with excited waves in a collisionless plasma. Extensive numerical simulations were performed along with the development of analytic theories. These simulations allowed the author to assess the affect of inherent nonlinear processes on plasma dynamics and to compare the simulation results with the observed data.

43744 (AD-A-206459/0/XAB) **Relativistic electron-precipitation patterns in longitude and latitude: a reply to W. R. Sheldon. Technical report.** Baker, D.N.; Blake, J.B.; Gorney, D.J.; Higbie, P.R.; Klebesadel, R.W. Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab. 16 Feb 1989. 11p. (TR-0088(3940-06)-6). Available from NTIS, PC A03/MF A01.

In an earlier paper by the authors, a proposal was made that the precipitation of relativistic electrons from the outer magnetosphere into the Earth's atmosphere could have substantial effects on the chemistry of the middle atmosphere. It has been argued that the earlier estimates of precipitation fluxes may have underestimated the precipitation rates in isolated regions, such as the South Atlantic Anomaly, and overestimated the precipitation in other latitude and longitude sectors. Here, the discuss the factors that influence the longitudinal uniformity of relativistic electron precipitation and the implications of their earlier assumption of uniform precipitation.

43745 (AD-A-206733/8/XAB) **Multi-instrument studies of the auroral ionosphere. Final report, 1 November 1985-31 October 1988.** Foster, J.C. Haystack Observatory, Westford, MA (USA). 24 Mar 1989. 18p. Available from NTIS, PC A03/MF A01.

New data-collection modes and analysis techniques were developed that provide good time and spatial coverage and empirical models of the high latitude ionosphere. (1) The first three-radar azimuth scanning experiment was performed combining observations from Millstone Hill, Sondrestrom, and EISCAT to produce maps of the convection electric field at high latitudes at 30-minute intervals throughout an interval of increasing disturbance. (2) Empirical models of the ionospheric-convection electric field were developed from an extensive radar data base. (3) Quantitative models were developed describing the distribution of the field-aligned currents that link the ionosphere and magnetosphere at high latitudes. (4) A test of the local midnight-sector differences in the ionospheric convection models based on incoherent scatter radar data and those based on satellite observations was completed. (5) A new class of intense radar backscatter from the topside F region was identified as produced by parallel current-induced enhancement of the acoustic line. (6) The general characteristics of coherent radar backscatter from E-region irregularities as observed with the Millstone Hill UHF radar was the subject of an intensive study.

43746 (AD-A-206816/1/XAB) **Ground-based measurements of Joule heating rates.** De La Beaujardiere, O.; Johnson, R.; Wickwar, V.B. SRI International, Menlo Park, CA (USA). 3 Apr 1989. 23p. (SCIENTIFIC-1). Available from NTIS, PC A03/MF A01.

Joule heating in the upper atmosphere is the most-important energy-dissipation process between the magnetosphere and the ionosphere. This paper examines the various terms in the equation that governs Joule heating. (1) The ionospheric electric-field seasonal dependence is examined. It is found that the shape of the ionospheric plasma convection cells, and the latitude of the reversal from sunward to antisunward convection, are seasonally dependent. Statistical averages of the square of the ion velocity show a maximum in fall, and a minimum in summer. (2) Pedersen conductivities at F-region altitudes are examined using Chatanika and Sondrestrom radar data. It is shown that during solar minimum conditions, the F-region contributes less than 20% to the total height integrated Pedersen conductivity sigma p. In contrast, during solar maximum conditions the contribution to sigma from solar produced F-region ionization can be 60%. (3) The importance of the neutral wind term in Joule heating calculations is illustrated using a specific example. The Joule heating calculated by including the neutral wind term is 2 to 4 times smaller than that calculated without the neutral wind. But the reverse can also be true, as shown during a period when the neutral wind played the role of a dynamo in the ionosphere/magnetosphere current.

43747 (AD-A-206819/5/XAB) **Electrodynamics of the high-latitude ionosphere. Technical report.** Heelis, R.A. Texas Univ., Richardson, TX (USA). Center for Space Sciences. Nov 1988. 17p. (SCIENTIFIC-1). Available from NTIS, PC A03/MF A01.

A broad range of scientific investigations ranging from the development of large-scale models of ionospheric convection to small scale plasma flows associated with polar-cap arcs is described. It is shown that during times of northward IMF, coherent mesoscale convection features can frequently be identified at high latitudes. We now have the ability to quite accurately reproduce the convective features of the plasma at high latitudes during periods of southward IMF. Advances in understanding of electric-field coupling in plasma structures and the differences in local and height-integrated Joule heating rates are also described. The importance of the bottomside F-region concentration in determining the effectiveness of electrical coupling is emphasized.

43748 (AD-A-206821/1/XAB) **Model studies of the polar ionosphere. Final report, 28 August 1985-27 November 1988.** Sheehan, R.E. Boston Coll., Chestnut Hill, MA (USA). 21 Nov 1988. 88p. Available from NTIS, PC A05/MF A01.

This report presents modifications and additions to an ionospheric-chemistry computer program that models the high-latitude - polar-cap ionosphere (1-dimensional along a magnetic field line; 100-600 km altitude). Interest centers on effects of soft (1-kev) electron fluxes typically observed precipitating into the polar-cap ionosphere. Major changes involved incorporating an existing Q+ diffusion code with the Strickland local (E region) ionospheric-chemistry code and the addition of electron and ion temperature calculations based on the diffusion code. Also included are calculations of Hall and Pedersen electric conductivities and a separate program that determines electric currents in the ionosphere based on the model result; these were used in conjunction with measurements from the PIIE rocket campaign in Feb 1985. Some details of the numerical methods used in the various calculations are given, as well as an overview of the programming logic and a step-by-step description of program execution. The Strickland flux transport program that calculates production rates input to the chemistry model remains essentially unchanged, but a new parameterization scheme was developed that could have applications to global problems requiring a large number of flux calculations.

43749 (AD-A–206880/7/XAB) **Fully analytic, low- and middle-latitude ionospheric model.** Anderson, D.N.; Forbes, J.M.; Codrescu, M. Boston Univ., MA (USA). 1 Feb 1989. 6p. Available from NTIS, PC A02/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 94, No. A2, 1520-1524(1 Feb 1989).

A fully analytic ionospheric model emphasizing the low-latitude F region for various seasonal and solar-cycle conditions is presented. Features such as the post-sunset rise in the F-layer peak height and the 'equatorial anomaly' maxima in plasma density near + or - deg geomagnetic latitude are designed to closely approximate those in the semi-empirical low-latitude ionospheric model. Significant improvements are thus obtained over previous comparable analytic models. Numerical computations are also presented that demonstrate the importance of these large-scale plasma structures to the neutral dynamics of the low-latitude thermosphere. Equally significant effects are anticipated for the electrodynamic simulations of E region/F region coupling involving flux-tube integrated electrical conductivities.

43750 (AD-A–206881/5/XAB) **Magnetosphere - thermosphere coupling: an experiment in interactive modeling.** Forbes, J.M.; Harel, M. Boston Univ., MA (USA). 1 Mar 1989. 16p. Available from NTIS, PC A03/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 94, No. A3, 2631-2644(1 Mar 1989).

The Rice convection model (RCM) is utilized to investigate the electrodynamic coupling between the inner magnetosphere and the thermosphere including the effects of EUV- and convection-driven neutral winds under quasi-equilibrium conditions. It is shown that the parameters determining the coupling are the Pedersen and Hall effective winds, which are the height integrals of the respective conductivity-weighted wind profiles divided by the respective layer conductivities. Their appearance in the RCM is equivalent to a two-slab formulation whereby the integrated Hall conductivity originates in the lower slab, the integrated Pedersen conductivity originates in the upper slab, and the height dependence of the neutral wind is accounted for by assuming different wind vectors for the lower and upper slab. A unique aspect of the study is that the convection-driven winds are included self-consistently and interactively; that is, a steady-state wind parameterization is written analytically in terms of the electrostatic potential, which is in turn included in a closed-loop calculation for the electric potential itself. During the early phases of the disturbance when the normal shielding from high latitudes breaks down, the neutral winds do not modify appreciably the disturbance electric fields at middle and low altitudes. As the system approaches a quasi-equilibrium state, the neutral winds play a much more significant role. By comparison with the 'no-wind' simulation, the fields driven by EUV winds counteract the fields of magnetospheric origin and given the appearance of a shielding effect.

43751 (AD-A–207036/5/XAB) **Three-dimensional equilibrium and stability of ionospheric plasma clouds. Memorandum report.** Drake, J.F.; Mulbrandon, M.; Huba, J.D. Naval Research Lab., Washington, DC (USA). 22 Mar 1989. 67p. (NRL-MR–6436). Available from NTIS, PC A04/MF A01.

The equilibrium and stability of three-dimensional ionospheric plasma clouds is investigated. The equilibrium density profile is assumed to be a 3D waterbag with a circular cross section transverse to B, and an ellipsoidal cross section parallel to B. The equilibrium potential consists of two parts: a polarization potential driven by a uniform neutral wind, and an ambipolar potential driven by parallel electron pressure. The latter potential is shown to cause sheared azimuthal plasma flows perpendicular to B. A stability analysis of this equilibrium is carried out. It is found that the E X B instability, which causes the structuring of ionospheric plasma clouds, can be stabilized by the azimuthal flow. A marginal stability criterion is derived. On the basis of this stability criterion, striations of barium clouds in the ionospheric F region should be stable to further bifurcation, as is observed.

43752 (AD-A–207150/4/XAB) **Simultaneous radial and pitch-angle diffusion in the outer electron radiation belt. Report for 20 May 1985-1 January 1988.** Chiu, Y.T.; Nightingale, R.W.; Rinaldi, M.A. Lockheed Missiles and Space Co., Palo Alto, CA (USA). Lockheed Palo Alto Research Lab. 1 Apr 1988. 15p. (LMSC/F–307422). Available from NTIS, PC A03/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 93, No. A4, 2619-2632(1 Apr 1988).

A solution of the bimodal (radial and pitch angle) diffusion equation for the radiation belts is developed with special regard for the requirements of satellite radiation-belt data analysis. This paper uses this solution to test the bimodal theory of outer electron belt diffusion by confronting it with satellite data. Satellite observations, usually over finite volumes of (L,T) space, are seldom sufficient in space-time duration to cover the relaxation to equilibrium of the entire radiation-belt. Since time scales of continuous data coverage are often comparable to that of radiation-belt disturbances, it is therefore inappropriate to apply impulsive semi-infinite time-response solutions of diffusion theory to interpret data from a finite window of (L,t) space. Observational limitations indicate that appropriate solutions for the interpretation of satellite data are general solutions for a finite-volume boundary value problem in bimodal diffusion. Here, such a solution is tested as the prime candidate for comprehensive radiation belt dynamic modeling by applying the solution and developing a method of analysis to radiation-belt electron data obtained by the SCATHA satellite at moderate geomagnetic activity. The results and the generality of the solution indicate its promise as a new approach to dynamic modeling of the radiation belts.

43753 Expanding plasma structure and its evolution toward long wavelengths. Sgro, A. G. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545 (US)); Peter Gary, S.; Lemons, D. S. *Physics of Fluids B: Plasma Physics (USA)*, 1(9): 1890-1899 (Sep 1989).

The expansion of a plasma slab across an initially uniform magnetic field is simulated by the use of a two-dimensional electromagnetic hybrid (particle ions, fluid electrons of nonzero mass) computer code. The expanding plasma develops magnetic-field-aligned structure on time scales faster than an ion gyroperiod. Through the full duration of the m_i/m_e =100 simulation, the structure wavelength is well predicted by the wavelength at maximum growth rate from the linear Vlasov theory of the lower hybrid drift instability modified by deceleration. At m_i/m_e =400, the late time structure wavelength is about 1.5 times the early time value. At m_i/m_e =1836, the structure wavelength at early times is close to that corresponding to the maximum growth rate of linear theory, while at later times the structure wavelength becomes about twice as long as its early time value. These three results suggest that the ratio of the late time wavelength to the early time value gradually increases with m_i/m_e. Extrapolation of this scaling to larger m_i/m_e values is consistent with structure wavelengths observed in an expanding aluminum plasma experiment [J. Appl. Phys. J. **20**, 157 (1981)], as well as the observed wavelength in the expanding barium plasma of the AMPTE magnetotail experiment [J. Geophys. Res. **92**, 5777 (1987)].

43754 Development of flute modes on expanding plasma clouds. Winske, D. (Applied Theoretical Physics Division, Los Alamos National Laboratory, MS-E531, Los Alamos, New Mexico

87545 (US)). *Physics of Fluids B: Plasma Physics (USA),* 1(9): 1900-1910 (Sep 1989).

Structuring that results from plasma streaming at sub-Alfvenic speeds across an external magnetic field is considered. Previously, it has been proposed the lower hybrid drift instability enhanced by the deceleration of the plasma by the field produces the flute modes observed on the surface of expanding laser produced plasmas and the AMPTE magnetotail releases [Eos (Trans) 63, 843 (1982)]. An appropriate dispersion equation to describe the properties of the unstable waves has been derived and particle simulations carried out to show the growth and evolution of the instability. The salient features of this earlier work are reviewed here, and then additions and refinements to the theory and simulations are described. In particular, the scaling of the wave properties with the ratio of the ion gyroradius to the magnetic confinement radius is discussed and the nonlinear evolution of the instability is investigated more thoroughly. The consequences of these results, both for the laser experiments and for AMPTE, are also considered. To this end, a comparison of the linear and nonlinear properties of the waves observed in the simulations with those seen in the experiments is carried out. While there is considerable discrepancy between the observed and predicted wavelengths of the modes, the effects considered here are in the direction of reducing the disagreement.

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Refer also to citation(s) 42882, 42884, 42924, 42929, 43411, 43714, 43928, 43932, 44174, 44316, 44318, 44320, 44324, 44327

43755 (AD-A-206400/4/XAB) **Resonances in near-threshold x-ray photoabsorption of inner shells.** Manson, S. Georgia State Univ., Atlanta, GA (USA). Dept. of Physics. Dec 1987. 5p. Available from NTIS, PC A02/MF A01.

Pub. in Jnl. de Physique, Supp. 12, Vol. 48, C9-951-C9-954(Dec 1987).

Synchrotron-radiation measurements of near-threshold and broad-range (20 eV-3 keV) absolute photoabsorption cross sections were made at the Brookhaven National Laboratory (NSLS) and at Stanford (SSLR). Transmission data for well-characterized multilayer foils provided absolute corss sections with 10% overall uncertainties and better than 0.2% energy resolution. Several examples of the results are presented.

43756 (AD-A-206444/2/XAB) **Use of Gaussian-type functions in Dirac-Fock basis-set expansion calculations.** Ishikawa, Y.; Sekino, H. Puerto Rico Univ., Rio Piedras (Puerto Rico). 1988. 8p. Available from NTIS, PC A02/MF A01.

Pub. in International Jnl. of Quantum Chemistry: Quantum Chemistry Symposium 22, 457-463(1988).

Dirac-Fock balanced Gaussian-basis calculations that employ an extended-nucleus model were performed on Be and Ne atoms by systematically enlarging the basis set. As expansion size increases, the total energy smoothly converges toward the numerical Dirac-Fock limit from above. The balanced expansion method does not introduce any of the variational instabilities that have plagued the early Dirac-Fock-basis expansion calculations.

43757 (AD-A-206833/6/XAB) **High altitude plume emissions in atmospheric-window region.** Sharma, R.D.; Bakshi, P.; Sindoni, J. Air Force Geophysics Lab., Hanscom AFB, MA (USA). Feb 1989. 19p. (AFGL-TR-89-0082). Available from NTIS, PC A03/MF A01.

Quantum-Mechanical Spectator model (Impulse Approximation) is used to calculate the cross section for rotation-vibration excitation of CO during collision with atomic oxygen at relative velocity (energy) of 5 (1.3), 8 (3.3), 11 (5.3), and 14 km/s (10.2 eV). The calculation is carried out for initial CO vibrational level v=o and rotational levels J=O and J=10 and final vibrational levels v'=o - 6 and final rotational levels up to J'=100. It is shown that the final results are almost independent of the initial rotational level. The rotational distribution in the final vibrational levels is rather flat and cannot be described by a Maxwell-Boltzmann distribution. The final rotation-vibration distributions are translated into relative emission in the 4.7-micron region. The emitted radiation from each level shows an R-branch bandhead around 4.4 microns with P-branch extending beyond 6 microns. It is expected that carbon dioxide and water generated by the plumes at high altitudes, upon collision with atomic oxygen, would also emit band infrared radiation around 6, 4.3, and 2.7 microns.

43758 (AD-A-206936/7/XAB) **Dynamics of excited high-lying states of H_2 and D_2. Final reportM 5 May 1986-4 October 1988.** Kachru, R.; Helm, H. SRI International, Menlo Park, CA (USA). Nov 1988. 76p. (SRI-MP-88-234). Available from NTIS, PC A05/MF A01.

The spectroscopy and dynamics of Rydberg states of molecular hydrogen is important in modeling discharge- and electron-beam-pumped lasers, molecular ion electron collisions, and the photoionization of molecular hydrogen. The primary objective was to investigate the excited states of H_2 and D_2 as two prototypes for a systematic study of manifestations of the static and dynamic interactions governing molecular Rydberg states. The experimental approach employed a stepwise laser-excitation scheme. Detection of the charged molecular, atomic fragments, and the energy-analyzed electrons enabled measurement of autoionization, ionization, dissociation, and the competition between them. The authors studied and analyzed the np autoionizing Rydberg states in H_2. We also studied the competition between photoionization and photodissociation from the $C1\Pi u H_2$ state. In addition, they performed the first study of the onset of field ionization and the forced rotational autoionization of the np Rydberg states. They demonstrated that the ionization process can be described classically.

43759 (AD-A-206987/0/XAB) **Updated excitation and ionization cross sections for electron impact on atomic oxygen. Technical report, 1 October 1987-29 February 1988.** Laher, R.R.; Gilmore, F.R. R and D Associates, Marina del Rey, CA (USA). 29 Feb 1988. 97p. (RDA-TR-135603-009). Available from NTIS, PC A05/MF A01.

Cross sections for the excitation and ionization of atomic oxygen by electron impact are presented as the result of a critical review of experimental and theoretical work on this subject. An effort was made to compile the most accurate and complete set of cross sections available. More than 60 profiles of excitation cross sections versus electron-impact energy are presented. These include transitions to the forbidden metastable O(1D) and O(1S) states, the allowed autoionizing O(2p5 3po) state, nine allowed Rydberg series, and twenty nine forbidden Rydberg series. Recommended ionization cross sections for transitions to the outer electron ionization states O+ (4so), O+(2do), and O+(2po), to the inner electron ionization state O+(4p), and to the O2+ state are also given. Many of these excitation and ionization cross sections are based on recently published laboratory measurements, and differ from previously accepted values by factors of approx. 2-3, and in a few cases by up to a factor of 10.

43760 (AECL-9502) **Program COPSI.** Lee-Whiting, G.E.; Petrovich, G.A. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Jun 1987. 31p. Order Number DE89633965/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The program COPSI (Calculation of Product Surface Irradiation) for calculating the distribution of linac-generated electrons over the surface of a product being irradiated is described. The lenses, momentum analyzer and scanner in the system are treated in first-order optics. An idea for a one-dimensional scanner free of edge focusing is discussed. The effects of the initial distributions in phase space and of multiple scattering in the window and in the air between the window and the product are both included approximately.

43761 (CONF-890697-2) **Electron collisions in gas switches.** Christophorou, L.G. Oak Ridge National Lab., TN (USA). 1989. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From NATO Advanced Study Institute on non-equilibrium processes in partially ionized gases; Acquafredda di Maratea (Italy); 4-17 Jun 1989. Order Number DE89015307/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Many technologies rely on the conduction/insulation properties of gaseous matter for their successful operation. Many others (e.g., pulsed power technologies) rely on the rapid change (switching or modulation) of the properties of gaseous matter from an insulator to a conductor and vice versa. Studies of electron collision processes in gases aided the development of pulsed power gas switches, and in this paper we shall briefly illustrate the kind of knowledge on

electron collision processes which is needed to optimize the performance of such switching devices. To this end, we shall refer to three types of gas switches: spark gap closing, self-sustained diffuse discharge closing, and externally-sustained diffuse discharge opening. 24 refs., 15 figs., 2 tabs.

43762 (CONF-890708–1) **Photodetachment collisions.** Pegg, D.J. Oak Ridge National Lab., TN (USA). 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 16. international conference on the physics of electronic and atomic collisions; New York, NY (USA); 26 Jul - 1 aug 1989. Order Number DE89015908/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A crossed-beams apparatus has been used to measure the cross sections (angular differential and integral) for photodetaching electrons from metastable He^- and stable B^- ions at λ = 696.2 nm. Kinematic effects were exploited, in a novel way, to enhance the precision of the measurements. The partial (angular integral) cross sections for He^- photodetachment are $\sigma(2^3S)$ = 22.9 $\pm$ 1.0 Mb and $\sigma(2^3P)$ = 10.0 $\pm$ 0.6 Mb. The corresponding cross section for B^- is $\sigma(2\ ^2)$ = 16.5 $\pm$ 2.1 Mb. The calculated cross section for the photodetachment of D^- was used to establish an absolute scale for the relative measurements. Radiative attachment cross sections are derived from the photodetachment results using the principle of detailed balance. 16 refs., 9 figs., 2 tabs.

43763 (DOE/ER/10578–T5) **Hyperfine structure and isotope shift measurements of short-lived elements by laser spectroscopy: Final report.** Schuessler, H.A. Texas A and M Univ., College Station, TX (USA). Dept. of Physics. Apr 1989. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract AS05-80ER10578. Order Number DE89016115/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report discusses the following topics: on-line collinear fast ion beam or atom beam laser spectroscopy on short-lived elements; and stored ion spectroscopy. (LSP)

43764 (DOE/ER/45130–4) **[Non-empirical interatomic potentials for transition metals, alloys, and semiconductors]: Annual progress report, 1988–1989.** Carlsson, A.E. Washington Univ., St. Louis, MO (USA). Dept. of Physics. 1989. 2p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-84ER45130. Order Number DE89016397/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

METALS/interatomic forces; ALLOYS/interatomic forces; SEMICONDUCTOR MATERIALS/interatomic forces; PROGRESS REPORT; METALS; ALLOYS

43765 (DOE/ER/60473–3) **Selective excitation, relaxation and energy channeling in molecular systems: Progress report, July 1, 1988–June 30, 1989.** Rhodes, W.C. Florida State Univ., Tallahassee, FL (USA). Inst. of Molecular Biophysics. 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-86ER60473. Order Number DE89015827/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This research program involves the theory of dynamical properties of complex molecular systems having many kinds of degrees of freedom and heterogeneous molecular structure. A general feature is how the dynamics of one subsystem are modulated by interactions with the remaining subsystems. Such modulation affects the response, relaxation, and the channeling of processes in the system as a whole. Quantum mechanical coherence and correlation among the components of the system underlie most of the effects encountered.

43766 (IAE–4623/12) **Structural peculiarities and molecular properties of charge complexes formed on positive ion injection into dense inert gas media.** Potapov, S.G.; Suchanov, L.P.; Gutsev, G.L. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1988. 21p. (In Russian). Order Number DE89633953/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The formation of charge complexes resulting from penetration of positive ions into the dense inert gas media is modelled on the basis of Hartree-Fock-Roothaan method calculations of the potential energy surface of proton interaction with n inert gas atoms R. It is shown that molecular ions of the type RH^+, R_2H^+ with binding energy $D_E \geq 0{,}3$ eV are formed at $n \leq 2$, and a polarization 'envelope' of atoms R around ion R_2H^+ is formed only at $n \geq 3$. Using the results of Hartree-Fock calculations on vibrational spectra and those of discrete variational X_α-method calculations on the electronic spectra, the capabilities of experimental optical registration of the predicted ion-molecular compounds in dense inert gas media are analyzed. 37 refs.; 3 figs.; 4 tabs.

43767 (INIS-SU–100, pp. 19-23) **Gamma ray internal conversion lines shift resulting from atom ionization after electron capture.** Bulgakov, V.V. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij); Kupryashkin, V.T.; Lashko, A.P. and others. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

Energy differencies of four couples of transitions in γ- and conversion spectra of ^{152}Eu and ^{184}Re isomers are measured with high precision. γ-spectra are measured using the HGe detectors. The spectra of conversion electrons are measured using the magnetic high-resolution beta-spectrometer of the $\pi\sqrt{2}$ type. The comparison of energy differences of γ-rays of 963 and 970 keV transitions with the energy difference of their K-lines has revealed the effect of K-line internal conversion shift which is 20$\pm$7eV for K963 transition resolving the level from $T_{1/2}$=3x10^{-14}s ^{152}Sm. The comparison of energy differences of 963 and 964 keV transitions has produced the shift value for K963 20$\pm$9eV. The average weighted value of these two independent measurements is 20$\pm$6eV. For conversion transitions resolving more long-lived levels ($T_{1/2} \geq 9x10^{-13}$s) the effect is not found. The lifetime of atoms in the ionized state is estimated. 11 refs.; 2 figs.; 1 tab.

43768 (INIS-SU–100, pp. 82-85) **Influence of the atomic effects on the annihilation process of slow positrons with inner atomic shells.** Batkin, I.S. (Voronezhskij Gosudarstvennyj Univ., Voronezh (USSR)); Demakov, S.L.; Churakova, T.A. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The annihilation of positrons with the energy from 0.3 to 20 keV undergoing the significant effect of screening with K- and L-shell electrons of inert gases is considered. Wave functions of the bound electron and collising positron are found by the numerical solution of the Dirac equation with the Hartree-Fock-Slater potential. The polarizing effect of the positron on the atomic shell is not taken into account. The results of calculations show that the cross section of the annihilation process for slow positrons greatly increase as compared with the calculations for the Coulomb potential especially in the range of small energies. 2 refs.; 1 tab.

43769 (INIS-SU–100, pp. 98-103) **Oscillations of the angular distribution of positronium 3γ-quanta-annihilation in magnetic field.** Andrukhovich, S.K. (AN Belorusskoj SSR, Minsk (Byelorussian SSR). Inst. Fiziki); Baryshevskij, V.G.; Berestov, A.V. and others. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The earlier forecasted theoretically new phenomenon-time beating of the angular distribution of positronium 3γ-decay quanta in the magnetic field are experimentally studied for the first time. The theory of the phenomenon, the experimental device and the selection of optimum observation conditions are briefly described. The results obtained prove the existence of the beating effct, the characteristics

of oscillations observed correspond to the theoretical predictions. 6 refs.; 2 figs.; 1 tab.

43770 (JINR-N-4(30)-88, pp. 87-94) **Emission characteristics of $Y_1Ba_2Cu_3O_{7-\delta}$ cathode.** Korenev, S.A. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. In *JINR rapid communications. Collection of papers.* Order Number DE89012196/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; INIS.

The results are presented of experimental investigation of the electron beam in diode with cathode on the base of $Y_1Ba_2Cu_3O_{7-\delta}$. After corresponding cathode training, the cathode made from $Y_1Ba_2Cu_3O_{7-\delta}$ material may be practicable of stable current electron beam yeild. It is shown experimentally that the voltage of diode of about 100-300 kV there exists an evident possibility of forming the electron beams with the current density of 70 A-380 A/cm^2. The motion velicity of cathode plasma in the direction of anode for this material of a cathode amounts to (1-3)x 10^6 cm/s. 1 refs.; 4 figs.

43771 (KFK–4553) **X-ray emission of pseudo spark chambers.** Rogner, A. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik. Apr 1989. 119p. (In German). Order Number DE89796038/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Three types of X-ray sources can be classified in the high power Pseudo Spark: anode radiation, which is generated by the self-focused electron beam during the predischarge, radiation from the cathode surface, which has its origin in electrons hitting the walls at the beginning of the main discharge, and plasma radiation, which is emitted partially directed by a small plasma area in the hollow cathode region during the main discharge. The maximum quantum energies of anode and cathode wall radiation are corresponding to the discharge voltage, those of the plasma radiation are typically one to two orders of magnitude lower. The measurement of the X-ray emission is supporting the usual distinction of pre- and main discharge in the Pseudo Spark. Additionally can be shown, that the predischarge consists of a modified Townsend discharge with runaway-electrons in the discharge channel and a normal Townsend discharge with drifting electrons in the hollow cathode region. The events in the hollow cathode region are essential for the transition into the main discharge. A first application of the Pseudo Spark as an X-ray source was realised in an experimental upset for X-ray backlightning of ion beam targets. (orig.).

43772 (KFTI–87-60) **On the possibility of atom acceleration by the X radiation flux.** Shchagin, A.V.; Khizhnyak, N.A. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1987. 6p. (In Russian). Order Number DE89633978/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Mechanism of atom acceleration in x radiation flux at the expense of a pulse transmitted to the atom under a photoeffect from the internal shell is considered. It is ascertained that under the x-ray quantum energy E_γ >or approx.E_K (absorption K-edge energy) the atom is accelerated along radiation propagation trajectory and $E_\gamma \geq E_K$ the atom is accelerated in the opposite direction. A possibility of applying this effect for atom acceleration is considered for the first time. Formulae for acceleration rate are derived. The maximum possible acceleration rate performed for accelerated Ar atoms gives about 100 GeV/m under ~2.7x10^{23} W/cm^2 power flux. Such accelerator efficieny grows with the increase of accelerated atom finite energy $\sim\sqrt{E}$. Under Ar atom acceleration up to 1 GeV the accelerator efficiency is ~10%. Difficulties related to the way of this acceleration technique realization are discussed. A possibility of realizing the described acceleration mechanism under the natural conditions near x-ray astrophysical sources and its effect on the substance distribution in the cosmic space is underlined. Atom selection by mass occuring near such sources (the light atoms are accelerated towards the source and heavy ones-backwards) can be one of the reasons for relative enrichment of cosmic radiation by heavy elements and star enrichment by light elements (star fuel). A possible process of a star formation near the X-ray source is described. 6 refs.

43773 (LA-UR–89-2335) **Vibrational frequency shifts of fluid nitrogen fundamental and hot band transitions as a function of pressure and temperature.** Schmidt, S.C.; Schiferl, D.; Zinn, A.S.; Ragan, D.D.; Moore, D.S. Los Alamos National Lab., NM (USA). 1989. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890798–7: AIRAPT and EHPRG international high pressure science and technology conference, 17-21 Jul 1989). Order Number DE89015268/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Coherent anti-Stokes Raman scattering (CARS) and spontaneous Raman spectroscopy have been used to obtain vibrational spectra of shock-compressed and static high-pressure fluid nitrogen, respectively. Vibrational frequencies were obtained from the CARS data using a semiclassical model for these spectra. Spontaneous Raman vibrational frequencies were determined by fitting data using a Lorentz shape line. A functional form was found for the dependence of the vibrational frequency on pressure and temperature to 40 GPa and 5000 K, respectively. The result is compared to a recent theoretical model. 6 refs., 2 figs., 1 tab.

43774 (LA-UR–89-2473) **Observation of excited H^0 atoms produced by relativistic H^- ions in carbon and formvar foils.** Mohagheghi, A.H.; Bryant, H.C.; Harris, P.G.; Tang, C.Y.; Quick, C.R.; Reeder, R.A.; Cohen, S.; Smith, W.W.; Stewart, J.E. Los Alamos National Lab., NM (USA). 8 Feb 1989. 27p. Sponsored by DOD;DOE/ER. DOE Contract W-7405-ENG-36;AS04-77ER03998. (CONF-890708–2: 16. international conference on the physics of electronic and atomic collisions, New York, NY (USA), 26 Jul - 1 aug 1989). Order Number DE89015301/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have measured the relative yield of several low-lying excited states of neutral hydrogen atoms produced by the passage of 226-MeV and 581-MeV H^- ions through thin carbon foils and a tilted formvar foil. The relative yields of H^-_*(n = 2,3, 4) were measured for 17 different carbon foils ranging in thickness from 662 Å to 5386 Å at 581 MeV. The relative yield of H^0*(n = 2) was also measured for these carbon foils at 226 MeV. These data exhibit a significant deviation from a simple yield curve indicating that a more complex mechanism than has previously been thought is responsible for producing the excited states. The relative yields of H^0*(n = 2,3) were measured for a tilting formvar foil at 226 MeV; unexplained dips appear at incidence angles of $\theta \approx 12°$ and $\theta \approx 15°$ in the yield of n=2 and n=3 states, respectively. 19 refs., 7 figs., 1 tab.

43775 (LBL–26795) **In-situ density and temperature measurements of vibrationally-excited hydrogen molecules in ion source plasmas.** Stutzin, G.C.; Young, A.T.; Doebele, H.F.; Schlachter, A.S.; Leung, K.N.; Kunkel, W.B. Lawrence Berkeley Lab., CA (USA). Jun 1989. 14p. Sponsored by DOD;DOE/ER. DOE Contract AC03-76SF00098. (CONF-890703–15: International conference on ion sources, 9-15 Jul 1989). Order Number DE89016315/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The role of highly vibrationally-excited hydrogen molecules has been postulated to be of great importance in H^- ion sources. However the difficulty of making in-situ measurements has led to a paucity of direct determinations of these species within the plasma of these sources. Recently, vacuum-ultraviolet (VUV) laser absorption spectroscopy has been used to measure the H_2 rovibrational populations up to $v'' = 5$ and $J'' = 8$ in a medium-power hydrogen plasma. This work extends those measurements to $v'' = 8$ and to $J'' = 13$. The populations of the vibrational levels still appear to be almost Boltzmann. The theoretically predicted plateau is not observed up to the detection limit. The dependence of several vibrational levels on discharge current and filling pressure is shown. 15 refs., 4 figs.

43776 (LBL–27468) **Threshold photoelectron spectrum of the Argon 3s satellites.** Medhurst, L.J.; Von Wittenau, A.S.; van Zee, R.D.; Zhang, J.S.; Liu, S.H.; Shirley, D.A.; Lindle, D.W. Lawrence Berkeley Lab., CA (USA). Jul 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89015338/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Lately a variety of techniques have studied the electron correlation satellites with binding energies between the Argon 3s binding energy (29.24 eV) and the $2p^{-2}$ ionization potential (43.38 eV). One of these techniques, Threshold Photoelectron Spectroscopy, with ~90 meV FWHM resolution, revealed at least 25 individual electronic

states. All of these could contribute to any other satellite spectrum, and this helped explain some discrepancies between previous measurements. This technique has been applied to the same region with higher resolution (<60 meV at the Ar $3s^{-1}$peak). In this higher resolution spectrum at least 29 individual electronic states are present. In some cases the multiplet splitting is observed. 12 refs., 2 figs.

43777 (PB–89-186464/XAB) **Absolute cross sections for molecular photoabsorption, partial photoionization, and ionic photofragmentation process.** Gallagher, J.W.; Brion, C.E.; Samson, J.A.R.; Langhoff, P.W. Joint Inst. for Lab. Astrophysics, Boulder, CO (USA). 1988. 145p. Available from NTIS(Order as PB–89-186449).

Included in Jnl. of Physical and Chemical Reference Data, Vol. 17, No. 1, 9-149(1988). Available from American Chemical Society, 1155 16th St., NW, Washington, DC 20036.

A compilation is provided of absolute total photoabsorption and partial-channel photoionization cross sections for the valence shells of selected molecules, including diatomics (H2, N2, O2, CO, NO) and triatomics (CO2, N2O), simple hydrides (H2O, NH3, CH4), hydrogen halides (HF, HCl, HBr, HI), sulfur compounds (H2S, CS2, OCS, SO2, SF6),and chlorine compounds (Cl2, CCl4). The partial-channel cross sections presented refer to production of the individual electronic states of molecular ions and also to production of parent and specific fragment ions, as functions of incident photon energy, typically from approximately 20 to 100 eV. Photoelectron anisotropy factors, which together with electronic partial cross sections provide cross sections differential in photon energy and in ejection angle, are also reported. There is generally good agreement between cross sections measured by the physically distinct optical and dipole electron-impact methods. The cross sections and anisotropy factors also compare favorably with selection ab initio and model potential (X-alpha) calculations which provide a basis for interpretation of the measurements.

43778 (PB–89-186472/XAB) **Energy levels of molybdenum, Mo 1 through 42.** Sugar, J.; Musgrove, A. National Bureau of Standards, Washington, DC (USA). Center for Radiation Research. 1988. 85p. Available from NTIS(Order as PB–89-186449).

Included in Jnl. of Physical and Chemical Reference Data, Vol. 17, No. 1, 155-239(1988). Available from American Chemical Society, 1115 16th St., NW, Washington, DC 20036.

The energy levels of the molybdenum atom, in all stages of ionization for which experimental data are available, were compiled. Ionization energies, either experimental or theoretical, and experimental g-factors are given. Leading components of calculated eigenvectors are listed.

43779 (PNL–6500-Pt.4, pp. 23-25) **Multiple ionization of atoms by ion impact.** DuBois, R.D. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

In order to model the energy deposition of fast ions as they slow down in gaseous media, information about the ionization occurring in collisions between ions and target atoms/molecules is required. Our measurements of doubly differential electron emission cross sections provide detailed information about the ionization process but do not provide any information about the final states of the target. They also do not distinguish between the emission of one or more target electrons in a single collision. It is important to know the relative importance of multiple-, with respect to single-, target ionization in order to accurately model the energy deposition. To date, multiple ionization of He, Ne, Ar, Kr, and Xe targets has been studied. Primarily, H and He ions were used, although some data for heavier ions (C,N and O) have also been obtained.

43780 The vacuum ultraviolet FEL for laser cooling of H atoms. Sander, R.K. (Los Alamos National Lab., Chemical and Laser Sciences Div., MS J567, Los Alamos, NM (US)). vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

The vacuum-ultraviolet free electron laser (VUV FEL) promises to provide a quantum jump in vacuum-ultraviolet light intensity and spectral brightness. The ideas suggested by the values of these parameters are more akin to the laser experiments of the visible region than traditional VUV photophysics and photochemistry. The first two-photon effect observed in the visible was Raman scattering. Shortly after the invention of the laser, other nonlinear optical effects such as four-wave mixing, third harmonic generation, and two-photon absorption were observed. Only in the last few years have dramatically nonlinear effects, which involve the cooperative absorption of hundreds or thousands of visible photons, been observed.

43781 High-resolution photoemission studies of transuranic actinides with an XUV-FEL. Cox, L.E. (Materials Science and Technology Div., Los Alamos National Lab., Los Alamos, NM (US)). vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

The evolution of electronic structure across the actinide series is unique in the periodic table. At the beginning of the series of 5f electrons are clearly involved in bonding and are well described by band theory; beyond Pu, however, localization occurs and magnetic and other physical properties indicate a transition to atomic-like behavior has taken place. In the valence-band photoemission spectra this change is manifested by the recession of 5f spectral weight from the Fermi energy and the appearance of multiplet structure. The latter results from the coupling of electron spin and angular momentum in the 5f-ionized final state. The situation is in principle analogous to 4f photoemission in the lanthanides which are well understood, and for which the final-state multiplet intensities can be calculated accurately from atomic theory.

43782 High resolution photoelectron spectroscopy. Arko, A.J. (9512470). vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

Photoelectron Spectroscopy (PES) covers a very broad range of measurements, disciplines, and interests. As the next generation light source, the FEL will result in improvements over the undulator that are larger than the undulater improvements over bending magnets. The combination of high flux and high inherent resolution will result in several orders of magnitude gain in signal to noise over measurements using synchrotron-based undulators. The latter still require monochromators. Their resolution is invariably strongly energy-dependent so that in the regions of interest for many experiments (h upsilon > 100 eV) they will not have a resolving power much over 1000. In order to study some of the interesting phenomena in actinides (heavy fermions e.g.) one would need resolving powers of 10^4 to 10^5. These values are only reachable with the FEL.

43783 On the relevance of extrinsic defects to melting. Lutsko, J.F. (9502104); Wolf, D.; Phillpot, S.R.; Yip, S. *Scripta Metallurgica (USA),* 23(3): 333-338 (Mar 1989).

Three basic classes of theories of melting have been proposed. The first treats the phenomenon as a homogeneous, bulk process involving a lattice instability, in which the (temperature-dependent) normal modes of the lattice become unstable at sufficiently high temperature. The second involves a mechanical instability occurring when the concentration of intrinsic (i.e., thermally-generated) defects reaches a critical concentration. The third class, originating from experimental observation, describes melting as nucleating at extrinsic defects such as free surfaces, grain boundaries (GBs) etc. Several recent measurements demonstrate that when the surface conditions are modified, the melting point can be depressed or the solid can be substantially superheated. The implication is that melting is basically a heterogeneous process and the mechanism of nucleation at extrinsic defects generally determines the kinetics.

43784 Measurement of the $(1s)(2p_{1/2})$ 2^3P_0-$(1s)(2p_{1/2})$ 2^3P_1 fine-structure splitting in heliumlike Ag^{45+}. Marrus, R. (Physics Department, University of California, Berkeley, California 94720 (US)); Simionovici, A.; Indelicato, P.; Dietrich, D. D.; Charles, P.; Briand, J.; Finlayson, K.; Bosch, F.; Liesen, D.; Parente, F.; and

others. *Physical Review Letters (USA),* 63(5): 502-504 (31 Jul 1989). DOE Contract W-7405-ENG-48.

A new method is described which is capable of determining $|\Delta E_{0-1}|$, the absolute value of the fine-structure splitting of the interval 2^3P_0-2^3P_1 from the hyperfine quenched lifetime of the 2^3P_0 state of heliumlike ions with nuclear spin. Based on this method a measurement is reported of $|\Delta E_{0-1}|$ in the heliumlike ion $^{107}Ag^{45+}$ with the result $|\Delta E_{0-1}|=0.74^{+0.16}_{-0.19}$ eV. The error in the measurement is substantially smaller than the natural linewidth of 1.1 eV.

43785 Wavelengths for n=4–5 transitions in Cu-like Ta, Au, Pb, and Bi. Brown, C. M. (E. O. Hulburt Center for Space Research, Naval Research Laboratory, Washington, D.C. 20375-5000 (US)); Seely, J. F.; Feldman, U.; Cobble, J. A.; Goldstone, P. D. *Journal of the Optical Society of America B: Optical Physics (USA),* 6(8): 1433-1436 (Aug 1989). DOE Contract AC08-80DP40124.

Transitions of the type n=4–5 in Ta^{44+}, Au^{50+}, Pb^{53+}, and Bi^{54+} were observed in the spectra from laser-produced plasmas that were recorded by a grazing-incidence spectrograph. Wavelengths in the range 9–19 A were measured with an uncertainty of ±0.015 A and were compared with previously measured and predicted wavelengths.

43786 The Ba $5d_{5/2}nd_j$, J=4 states and their interaction with the $5d_{3/2}\epsilon d_{5/2}$ J=4 continuum. Dai, C. J. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901 (US)); Jaffe, S. M.; Gallagher, T. F. *Journal of the Optical Society of America B: Optical Physics (USA),* 6(8): 1486-1491 (Aug 1989).

We report measurements of the Ba $5d_{5/2}nd$ J=4 states with emphasis on the two series above the $5d_{3/2}$ limit. These two series appear as a regular series of doublets exhibiting asymmetric profiles of finite width. We have fitted the observed spectra above the $5d_{3/2}$ limit using the quantum defect parameters obtained from the interseries interaction below the $5d_{3/2}$ limit using the Lee and Lu form of quantum defect theory and an adaptation of the Cooke and Cromer method. Both methods give identical fits to the data, and they predict differences in other observable parameters.

43787 Chlorinelike spectra of copper to molybdenum. Kaufman, V. (Atomic and Plasma Radiation Division, National Institute of Standards and Technology, Gaithersburg, Maryland 20899 (US)); Sugar, J.; Rowan, W. L. *Journal of the Optical Society of America B: Optical Physics (USA),* 6(8): 1444-1446 (Aug 1989).

Spectra of Cu to Mo (except for Rb and Sr) were generated in tokamak and laser-produced plasmas and observed photographically. Six lines have been identified in each of the spectra as Cl-like $3s^23p^5$–$3s^23p^43d$ transitions. Wavelengths in the range of 75–150 A, measured with an uncertainty of ±0.005 A, are given. Line classifications were made by comparing the observed wavelengths and relative intensities with those calculated using the relativistic average-of-configuration Hartree–Fock code of Cowan. Predicted values for the corresponding wavelengths of Cl-like Rb and Sr were obtained from these comparisons, with an uncertainty of ±0.010 A.

43788 Low-energy electron capture by N^{3+}, N^{4+}, and N^{5+} from hydrogen atoms using merged beams. Huq, M. S. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6372 (US)); Havener, C. C.; Phaneuf, R. A. *Physical Review [Section] A: General Physics (USA),* 40(4): 1811-1816 (15 Aug 1989). DOE Contract AC05-84OR21400.

Measurements of absolute total cross sections for single-electron capture in collisions of N^{3+}, N^{4+}, and N^{5+} ions with ground-state atomic hydrogen are reported in the energy region 0.9–1400 eV/amu. Good agreement is obtained with available theoretical calculations and with previous experimental results at the higher energies. None of the systems studied shows a clear signature of the induced-dipole attractive force in enhancing the cross section.

43789 Close-coupling cross sections for electron-impact excitation of Kr^{26+}. Reed, K. J. (High Temperature Physics Division, Lawrence Livermore National Laboratory, Livermore, California 94550 (US)); Henry, R. J. W. *Physical Review [Section] A: General Physics (USA),* 40(4): 1823-1827 (15 Aug 1989). DOE Contract W-7405-ENG-48.

Coupling effects among the channels for collisional excitation of $2s^22p^4$, $2s2p^5$, and $2p^6$ configurations of oxygenlike krypton have been reinvestigated and found to be small. In an earlier publication, it was reported that coupling to the $2s2p^5$ $^3P^o$ state has a strong influence on the cross section $\sigma(2s^22p^4P \rightarrow 2p^6\ ^1S)$. That apparent coupling is shown to be due to an inconsistency involving orthogonality and correlation functions. We solve the correct set of coupled integrodifferential equations using the niem, Σ, and rmatrix codes. All three calculations are performed using the same atomic states and the same configurations to describe the target. We find very good agreement among the cross sections obtained from all three codes. We also calculated distorted-wave cross sections for the same set of transitions. The distorted-wave results are nearly identical to the results obtained with the close-coupling codes.

43790 Hyperfine structure of some excited states of $^{133}Cs^+$ by collinear laser-ion beam spectroscopy. Sen, A. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439 (US)); Childs, W. J. *Physical Review [Section] A: General Physics (USA),* 40(4): 2159-2162 (15 Aug 1989). DOE Contract W-31-109-ENG-38.

Hyperfine structure of a few excited states of $^{133}Cs^+$ in the $5p^55d$ and $5p^56p$ configurations has been measured by laser-induced fluorescence with a collinear laser and slow-ion-beam (~1.5 keV) apparatus. The hyperfine spectrum for the optical transition at 612.86 nm has been recorded for the first time. The full width at half maximum of the laser-induced fluorescence spectra recorded with our apparatus is typically 45–75 MHz. The magnetic dipole (A) and electric quadrupole (B) hyperfine constants have been determined for the two lower levels $5p^55d$ $^3P_2$, $^3F_4$ and the two upper levels $5p^56p$ $(3/2[3/2]_d,\ 3)/2\ [5/2]_3$ at energies 112 803.99, 112 245.44, 129 998.63, and 129 116.56 cm^{-1}, respectively, above the ground state, $5p^6\ ^1S_0$.

43791 A simple model for correcting the zero point energy problem in classical trajectory simulations of polyatomic molecules. Miller, W. H. (Department of Chemistry, University of California and Materials and Chemistry Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720 (US)); Hase, W. L.; Darling, C. L. *Journal of Chemical Physics (USA),* 91(5): 2863-2868 (1 Sep 1989). DOE Contract AC03-76SF00098.

A simple model is proposed for correcting problems with zero point energy in classical trajectory simulations of dynamical processes in polyatomic molecules. The "problems" referred to are that classical mechanics allows the vibrational energy in a mode to decrease below its quantum zero point value, and since the total energy is conserved classically this can allow too much energy to pool in other modes. The proposed model introduces hard sphere-like terms in action–angle variables that prevent the vibrational energy in any mode from falling below its zero point value. The algorithm which results is quite simple in terms of the cartesian normal modes of the system: if the energy in a mode k, say, decreases below its zero point value at time t, then at this time the momentum P_k for that mode has its sign changed, and the trajectory continues. This is essentially a time reversal for mode k (only!), and it conserves the total energy of the system. One can think of the model as supplying impulsive "quantum kicks" to a mode whose energy attempts to fall below its zero point value, a kind of "Planck demon" analogous to a Brownian-like random force. The model is illustrated by application to a model of CH overtone relaxation.

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Refer also to citation(s) 44167, 44392

43792 (AD-A–205644/8/XAB) **MPD (Magnetoplasma Dynamic) thruster erosion research. Final report, 1 January-31 December 1987.** King, D.Q.; Callas, J.L. Jet Propulsion Lab., Pasadena, CA (USA). 30 Nov 1988. 34p. (JPL-D–6020). Available from NTIS, PC A03/MF A01.

The multimegawatt MPD (Magnetoplasma Dynamic) thruster is an electric engine capable of orbital transfer and maneuvering of large payloads driven by a megawatt-class space power supply. The MPD thruster is capable of specific impulses from 1,500 to 8,000 s. The high specific impulse means this system can perform missions using much less propellant than chemical systems. A five-MW MPD

electric system, propellant and payload from one shuttle launch must be replaced by the equivalent of four fully loaded Centaur G' stages. Thus, the savings in propellant and launch costs are very substantial. This report discusses 3 aspects of MPD thruster physics: (1) A significant operational problem which has limited the useful operation of the device is discussed. This is severe erosion of the insulator at the cathode insulator junction. A technique that appears to solve the problem has been tested, and is described. (2) A preliminary analyses of anode sheath is presented. (3) Analysis of the discharges two-dimensional nature is explored for the case where transverse gradients are considered but transverse velocity is assumed to be zero. This situation applies to high aspect ratio devices. The analyses concludes with: (a) a formalism that provides a means to qualitatively evaluate Ohmic dissipation from simple measurements of the magnetic Hall effect on magnetosonic choking (where thermodynamics is ignored).

43793 (AD-A-205716/4/XAB) **Population inversions in ablation plasmas generated by intense electron beams. Final report, 1 November 1985-31 October 1988.** Gilgenbach, R.M.; Kammash, T.; Brake, M.L. Michigan Univ., Ann Arbor, MI (USA). Dept. of Nuclear Engineering. Nov 1988. 130p. Available from NTIS, PC A07/MF A01.

Experiments during the past three years have concerned the generation and spectroscopic study of electron beam-driven carbon plasmas in order to explore the production of optical and ultraviolet radiation from nonequilibrium populations. The output of MELBA (Michigan Electron Long Beam Accelerator), has been connected to an electron-beam diode consisting of an aluminum (or brass) cathode stalk and a carbon anode. Magnetic-field coils were designed, procured, and utilized to focus the electron beam. A side viewing port permitted spectroscopic diagnostics to view across the surface of the anode. Spectroscopic diagnosis was performed using a 1-m spectrograph capable of operation from the vacuum-ultraviolet through the visible. This spectrograph is coupled to a 1024-channel optical multichannel analyzer. Spectra taken during the initial 400-ns period of the e-beam pulse showed a low effective-charge plasma with primarily molecular components (C_2, CH) as well as atomic hydrogen and singly ionized carbon (CII). When the generator pulse was crowbarred after the first 400 ns, the spectra revealed a continuation of the low-charge-state plasma. At times greater than 400 ns in non-crowbarred shots, the spectra revealed a highly ionized plasma with a very large intensity line at 2530 Angstroms due to CIV (5g-4f), and lower-intensity lines due to CIII and CII. This CIV line emission increased with time, peaking sharply between 750 and 900 ns, and decayed rapidly in less than 100 ns. Emission from these high ionization states may be due to electron beam-plasma instabilities, as this emission was accompanied by high levels of radio frequency and microwave emission.

43794 (AD-A-206678/5/XAB) **Diagnostics development for e-beam excited air channels. Technical report No. 4.** Stalder, K.R.; Williams, M.S.; Eckstrom, D.J. SRI International, Menlo Park, CA (USA). Feb 1989. 65p. (SRI-MP-88-292). Available from NTIS, PC A04/MF A01.

The conductivity of reduced density channels made by laser-initiated and exploding-wire-initiated discharges was measured systematically by microwave interferometry. The results show that the DC conductivity can be as high as 5×10^{10} for the laser channels and as high as 10^{11} for the exploding-wire channels. The channel temperature inferred from the conductivity levels is as high as 4000 K. The channels cool by adiabatic expansion, and subsequent turbulent convective mixing of the hot central plasma with the cold surrounding air; as a result, the conductivity drops to 5 x 10 to the 9th/s in 2-6 ms, depending on the initial discharge energy. The effects of impurities are discussed, as are the implications for charged particle beam propagation in such channels.

43795 (AD-A-207027/4/XAB) **Problems in dynamic phase transition. Final report, 1 September 1987-30 September 1988.** Hattori, H. West Virginia Univ., Morgantown, WV (USA). Dept. of Mathematics. 18 Nov 1988. 6p. Available from NTIS, PC A02/MF A01.

This paper, on the existence of intermediate magnetohydrodynamic shock waves, has used the technique called the connection matrix to establish one of the intermediate shocks that has not been shown to exist. There are a few approaches to the phase transition problem. One is to consider the momentum equation and another one is to consider the energy equation.

43796 (AD-A-207054/8/XAB) **Spectroscopic diagnostics of electron temperature and energy-conversion efficiency of laser-sustained plasma in flowing argon. Report for 1 September 1987-8 August 1988.** Mazumder, J.; Krier, H.; Chen, X. Illinois Univ., Urbana, IL (USA). Dept. of Mechanical and Industrial Engineering. 25 Aug 1988. 91p. (UILU-ENG-88-4014). Available from NTIS, PC A05/MF A01.

Laser-sustained plasmas are often formed during laser materials interaction. The University's 10-kW CW CO_2 laser was used to study argon plasmas for the application to laser supported propulsion and laser-materials processing. The spectroscopic diagnostic method was applied to study laser-sustained plasmas in 1 atmosphere pure argon gas flow with an f/7 on-axis laser-focusing scheme. High-flow speeds of 2 to 10 m/sec are achieved. Plasma electron-temperature distributions are determined from the 415.8-nm Ar I line and its adjacent continuum intensities. Plasma core temperatures as high as 20,000 K are reported. The total absorption of the incident laser power and the radiation loss by the plasma are calculated from the temperature distribution. Results indicated that up to 86% of the incident laser power can be absorbed and nearly 60% of the incident laser power can be retained by the flowing argon gas to provide thrust. Further research is called for in the laser induced fluorescence (LIF) technique for diagnostics of the downstream mixing zone and the plasma outer region. Experiments over a wider range of operating conditions, as well as multiple plasma testings, are required to find the optimum operating scheme.

43797 (ENEA-RT-FUS-88-05) **Collisional method to correct mesh distortion in two-dimensional Lagrangian hydrocodes.** Caruso, A.; Pais, V.A. ENEA, Frascati (Italy). Centro Ricerche Energia. Sep 1988. 17p. Order Number DE89761845/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Submitted to Il Nuovo Cimento.

Lagrangian numerical codes are widely used to simulate the evolution of fluids in very different regimes and conditions. Inertial confinement fusion applications deserve a special mention. The CCMM, a method to correct the distortion of cells used to zone fluids in two-dimensional Lagrangian hydrodynamic codes, is presented. Two representative cases are used to illustrate the operation of our code DUED, with and without this method. Even if the CCMM is CPU time consuming, it appears very useful to avoid convergency problems and/or error stopping simulations. By keeping the mesh ordering, the CCMM permits the continued simulation of the fluid hydrodynamics even in the presence of highly sheared motions where otherwise the run would stop.

43798 (LA-UR-89-2485) **The soft-sphere model for metals near the critical point.** Shaner, J.W. Los Alamos National Lab., NM (USA). [1989]. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890798-4: AIRAPT and EHPRG international high pressure science and technology conference, Paderborn (Germany, F.R.), 17-21 Jul 1989). Order Number DE89015298/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The soft-sphere model is convenient and accurate for predicting fluid phase thermodynamics. The validity of the model for describing the equation-of-state derivatives, Grueneisen's gamma and sound velocity, is shown. 7 refs., 2 figs.

43799 (LBL-25274) **Use of a distributed movie-making system for presentation of fluid flow data.** Robertson, D.W. Lawrence Berkeley Lab., CA (USA). 6 May 1988. 131p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89016467/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

Thesis. Submitted to San Francisco State Univ., CA.

This thesis describes work done to develop techniques for the graphical presentation of time-dependent 2- or 3-dimensional flow fields generated by fluid modelling together with a distributed computing software architecture to produce the graphics. The software runs on UNIX systems and uses interprocess communication with a TCP/IP based network protocol to implement the architecture. The

system components provide for communication between a video workstation consisting of a microcomputer controller, a frame buffer, a video recording device, and a front end system. The use of particle advection to graphically display the flow fields proper was investigated. The associated numerical calculations for transforming the data into graphical form are described, as are the relative merits and problems involved with this type of graphical display. The representation of the object(s) perturbing of constraining the flow is an important topic in itself, and issues involved in the implementation of features of the software which affect both the display of the object(s) and the flow field are discussed. An analysis is given of the use of video recording and playback as the final manner of presentation for a given data set. 48 refs., 42 figs., 4 tabs.

43800 Confined states in phase dynamics. Brand, H. R. (Fachbereich 7, Physik, Universitat Essen, D-4300 Essen 1, West Germany (US)); Deissler, R. J. *Physical Review Letters (USA),* 63(5): 508-511 (31 Jul 1989).

We discuss the possibility of the coexistence of two states with different wavelengths in the framework of phase dynamics. We investigate in detail this phenomenon which is intrinsically nonlinear and we give a Lyapunov functional for the case of a phase associated with a stationary pattern. The relationship of the confined states discussed here with recent experimental observations of localized states posessing a wavelength different from that in the bulk of the container for the case of slot convection and for the Taylor instability between co-rotating cylinders is critically examined.

43801 Collisional transport treatment of surface plasma structures. Montierth, L. M. (Los Alamos National Laboratory, X-1, E531, Los Alamos, New Mexico 87545 (US)); Morse, R. L.; Neuman, W. A. *Physics of Fluids B: Plasma Physics (USA),* 1(9): 1911-1925 (Sep 1989).

Calculations are shown of the structure of plasmas in equilibrium with solid surfaces that reemit incident plasma ions as relatively cold neutral gas. A numerical transport model that includes a Fokker–Planck treatment of ion–ion collisions obtains the distribution function for ions in a phase space of one spatial coordinate and two velocities. This is done self-consistently with an electrostatic potential, a Maxwell–Boltzmann description of electrons, and electron impact ionization of the reemited neutrals. Solutions are obtained from a higher temperature kinetic regime where Coulomb collisions are nearly negligible to a lower temperature regime where plasma behavior is approximately fluidlike. A result of these calculations is the resolution of an ambiguity posed by previous kinetic regime calculations that omitted ion–ion collisions and obtained a family of solutions for each set of physical parameters [Phys. Rev. Lett. **49**, 650 (1982); Phys. Fluids B **1**, 448 (1989)]. The physically correct solution for semi-infinite surface plasmas is shown to be the member of each family that maximizes the ion thermal conduction to the surface and the magnitude of a maximum in the electrostatic potential that is found in these and the previous calculations. Further results are in agreement at lower temperatures with solutions obtained from a fluid model and the identification of the correct boundary condition on normal flow velocity to be used in fluid models.

43802 Quantitative comparison of molecular dynamics with hydrodynamics in Rayleigh-Benard convection. Puhl, A. (Universite Libre de Bruxelles, Faculte des Sciences, Code Postal 231, Boulevard du Triomphe, B-1050 Brussels, Belgium (BE)); Mansour, M. M.; Mareschal, M. *Physical Review [Section] A: General Physics (USA),* 40(4): 1999-2012 (15 Aug 1989).

Two-dimensional convection in a compressible hard-disk fluid confined between free boundaries is studied from both a microscopic and a macroscopic level, i.e., by molecular-dynamics (MD) simulation on the one hand and by (analytical and numerical) solution of the hydrodynamic equations on the other hand. For a fluid of 5000 hard disks in a rectangular box of an aspect ratio of 2, both approaches are in remarkable quantitative agreement, showing a stable double-roll convection pattern in the final state. From the hydrodynamical point of view the system is just beyond instability (R=1.07R_c) and involves the nonlinear coupling of two modes (codimension-2 bifurcation). The simplest and optimal system to study with MD has an aspect ratio of 1 and involves 1500 particles only. Here, a stable single-roll pattern is observed. The hydrodynamic analysis, though, displays less good quantitative agreement with MD, which is due to the stronger influence of microscopic boundary effects.

6450 High Energy Physics

Refer also to citation(s) 42903

43803 Federal science policy. Hanson, H. P. (Executive Director, Committee on Science, Space, and Technology, U.S. House of Representatives, Washington, D.C. (US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(2): 2300-2310 (5 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, IL (USA), 20 Jul - 14 aug 1987).

I will give a short course, a very short course, in the political science of science. Next, I shall spend most of my time discussing the two policy studies in which our Committee on Science, Space, and Technology is engaged. Naturally they are a Science Policy Study and a Technology Policy Study. Finally, I want to give you a brief update on the battle of the budjet. (AIP)

6451 Particle Interactions and Properties - Experimental

Refer also to citation(s) 43722, 43734, 43842

43804 (ANL-HEP-CP–89-19) **Report of the QCD Working Group.** Hinchliffe, I.; Shapiro, M.D. Argonne National Lab., IL (USA). High Energy Physics Div. 13 Jan 1989. 67p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38;AC03-76SF00098. (CONF-8906178–1: Summer study on high energy physics in the 1990's, Snowmass, CO (USA), 27 Jun - 15 jul 1989; LBL–26574). Order Number DE89015139/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

We discuss some current problems associated with the applications of QCD to event rates in high energy collisions. Emphasis is given to the current ambiguities and uncertainties that exist in estimates of signals and backgrounds. The production of jets and isolated photons at hadron colliders is discussed in some detail. The problems of jet definition are addressed. Some features of the events underlying the hard scattering process are discussed. 72 refs., 32 figs., 3 tabs.

43805 (FNAL/C–89/151-E) **The production of J/ψ and associated particles in the collision of 530 GeV/c protons and pions with nuclear targets.** De, K.; Crittenden, R.; Dzierba, A.; Kartik, S.; Li, R.; Markham, S.; Marshall, T.; Martin, J.; Smith, P.; Sulanke, T. Fermi National Accelerator Lab., Batavia, IL (USA). Jan 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-8903143–4: 24. Recontres de Moriond: new results in hadronic interactions, Les Arcs (France), 12-18 Mar 1989). Order Number DE89016388/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have studied the production of the J/ψ and associated particles using the E672/E706 spectrometer at Fermilab. Preliminary results are presented from the first run in 1987–1988 with 530 GeV/c p/π^+ and π^- beams on a variety of nuclear targets. The A-dependance of J/ψ production with π^- beam was found to agree with an A^α parametrization with $\alpha = 0.85 \pm 0.06$ for $X_F > 0.1$. We have found that (41 $\pm$ 22)% of the J/ψ's produced in the p/π^+ beam are consistent with the radiative decay $\chi \rightarrow J/\psi+\gamma$. The future analysis goals of the experiment are also discussed. 10 refs., 9 figs.

43806 (INIS-SU–109/A, pp. 9-10) **On possible nature of X(2220) pseudoscalar.** Efrosinin, V.P. (AN SSSR, Moscow (USSR). Inst. Yadernykh Issledovanij). AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics.* Order Number DE89012198/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 10.

Character of mixing of pseudoscalar isosinglet and proposals about the nature of recently revealed resonance X(2220) with J^P=0 in radiation decay J/psi -> γX, X -> psipsi are discussed. 8 refs.; 2 tabs.

43807 (KEK–88-10) **Proceedings of the second meeting on physics at TeV energy scale.** Hidaka, K.; Koganei; Hikasa, K. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. V (CONF-8805174–: IAEA consultants' meeting on the physics of neutron emission in fission, 24-27 May 1988). Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

Individual papers in these proceedings are indexed separately.

43808 (LBL–27180) **Two photon production of pion pairs in e^+e_- collisions at 29 GeV.** Boyer, J.H. Lawrence Berkeley Lab., CA (USA). May 1989. 111p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89016310/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

We present a new measurement of the cross section for the process $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$ at center-of-mass energy 29 GeV for invariant pion pair masses $M_{\phi\phi}$ between 350 MeV/c^2 and 3.5 GeV/c^2. For $M_{\pi\pi}$ above 2.1 GeV/c^2, we find approximate agreement with the hard-scattering prediction of Brodsky and Lepage. In the low mass region, we observe the $f_2(1270)$, and measure its radiative width to be 3.15 ± .04 ± .39 keV. We also observe an enhancement in the $\pi^+\pi^-$ spectrum near 1 GeV. We hypothesize that it is the $f_0(975)$ and determine it's radiative width to be 0.29 ± .07 ± .12 keV. 48 refs.

43809 (LBL–27340) **Measurement of the η parameter in μ^+ decay.** Bossingham, R.R. Lawrence Berkeley Lab., CA (USA). Apr 1989. 156p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89016118/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This paper discusses the following topics on the muon plus decay; muon decay spectrum; previous determinations of η; experimental apparatus; distortions of the spectrum; and data analysis and results. 31 figs. (LSP)

43810 (LPNHEP–88-07) **Photon structure function study F_2^γ (x,Q^2) with CELLO detector.** Poggioli, L. Paris-11 Univ., 91 - Orsay (France). Jun 1988. 156p. (In French). Order Number DE89908090/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

This thesis is devoted to the experimental study of the photon structure function using the CELLO detector, settled down on the electron-positron storage ring PETRA at DESY (Germany). After a brief recall concerning the two components of the photon, i.e. the hadronic and point-like part, we review the different theoretical predictions, obtained in the QCD frame. We then introduce an alternative approach, based upon the use of a phenomenological cut in transfer to separate the hadronic and point-like components. We then emphasize the consequences of such an approach. The experimental study has been done first by looking at leptonic final state events, in order to measure the leptonic structure function, and to obtain a proper normalization. The hadronic final state events have been unfolded,, in order to express the results in terms of x true. A comparison to the different theoretical predictions is then performed, allowing to measure the parameters entering these predictions. As a conclusion, we stress the need for clearing out the situation on a theoretical point of view, and the difficulty to measure accurately the photon structure function, due to the limited acceptance of the detector.

43811 (PCCF-T–8806) **π^0 -> γ e^+e^- disintegration study. Electromagnetic form factor study of pion neutral.** Bensayah, M.N. Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire. 1988. 101p. (In French). Order Number DE89908092/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The experimental study of the Dalitz decay π^0 -> γe^+e^- allows the measurement of the π^0 electromagnetic form factor :F(X). ("X"is the (e^+e^-) invariant mass squared normalised by the π^0 mass squared). In most of the theoretical models (V.D.M., quarks triangle,...) F(X) is parametrized in the linear form: 1 + ax. "a" is called the slope of the π^0 electromagnetic form factor. To measure F(X), we have performed an experiment at the Saclay Linear Accelerator where a π^- beam was stopped in a hydrogen liquid target. The π^0 were produced by means of the charge exchange reaction π^-p -> $n\pi^0$. After having presented the theoretical models and the principles of the different methods allowing the measurement, we describe the experimental set up which essentially consists of a two-arms magnetic spectrometer determining the (e^+e^-) pair characteristics. Every (e^+e^-) pair coming from other reactions, than the Dalitz decay are regarded as background. The involved reactions are the inverse electroproduction π^-p -> ne^+e^- and the charge exchange π^-p -> $n\pi^0$ followed by the π^0 decays: π^0 -> $\gamma\gamma$, π^0 -> γe^+e^-, π^0 -> $e^+e^-e^+e^-$. In the two first modes of the π^0 decay, the Compton and the pair production effects may create parasite electrons. Finally, we study the different possible fits of the parameter "a" in our case and the quality of the simulation. We thus conclude that, at the present time, the simulation is not reliable enough to determine "a" and we discuss the improvements needed to allow its measurement.

43812 **BNL glueball review.** Toki, W. H. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309(US)). *AIP (American Institute of Physics) Conference Proceedings (USA)*, 185(1): 692-702 (25 Apr 1989). DOE Contract AC03-76SF00515;AC02-76ER01195;AC03-81ER40050;AM03-(CONF-880862–: BNL workshop on glueballs, hybrids and exotic hadrons, Upton, NY (USA), 29 Aug - 1 sep 1988).

The glueball session of the BNL workshop on glueballs, hybrids and exotic hadrons is reviewed. This include studies of $K\bar{K}\pi$, $\eta\pi\pi$, $\gamma\rho^0$,$\pi\pi$, $K\bar{K}$, $\eta\eta$, $\phi\phi$, $\rho\rho$, $\omega\omega$, and K^*K^* resonances produced in $\gamma\gamma$, J/ψ, K^-p and π^-p reactions.

43813 **Search for a neutral Higgs boson in *B*-meson decay.** Alam, M. S. (State University of New York at Albany, Albany, New York 12222 (US)); Katayama, N.; Kim, I. J.; Li, W. C.; Lou, X. C.; Sun, C. R.; Bortoletto, D.; Goldberg, M.; Horwitz, N.; Mestayer, M. D.; and others. *Physical Review [Section] D: Particles and Fields (USA)*, 40(3): 712-720 (1 Aug 1989).

Using the CLEO detector at the Cornell Electron Storage Ring we have searched for neutral-Higgs-boson production in *B* decay, both through the exclusive modes $B \rightarrow H^0K$ and $B \rightarrow H^0K^*$ using the decay of the H^0 into a pair of muons, pions, or kaons, and through the inclusive decay $B \rightarrow H^0X$ using only the muon decay of the H^0. We find no evidence for a Higgs boson with a mass between $2m_\mu$ and $2m_\tau$.

43814 **Searches for nonminimal Higgs bosons from a virtual *Z* decaying into a muon pair at the SLAC e^+e^- storage ring PEP.** Komamiya, S., et al. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309 (US)). *Physical Review [Section] D: Particles and Fields (USA)*, 40(3): 721-728 (1 Aug 1989). DOE Contract AC03-81ER40050.

Nonminimal neutral Higgs bosons decaying into a muon pair were searched for using the Mark II detector at the SLAC e^+e^- collider PEP at $\sqrt{s}$ =29 GeV. A neutral scalar Higgs boson H_s^0 can be produced accompanied by a pseudoscalar neutral Higgs boson H_p^0 via a virtual Z^0. If the mass of one of the Higgs bosons is between the muon pair threshold and the kaon pair threshold, it may decay predominantly into a muon pair. We looked for muon pair+jet(s) $[e^+e^- \rightarrow H_s^0H_p^0 \rightarrow \mu^+\mu^- + q\bar{q}(\tau^+\tau^-)]$ and three-muon-pair $[e^+e^- \rightarrow H_s^0H_p^0 \rightarrow 3(H_p^0) \rightarrow 3(\mu^+\mu^-)]$ topologies. We found no evidence for these signals above the known background level, and we obtained limits on $\Gamma(Z^0 \rightarrow H_s^0H_p^0)$ as a function of the Higgs-boson masses.

43815 **Study of vector-meson production in e^+e^- annihilation at $\sqrt{s}$ =29 GeV.** Abachi, S. (Argonne National Laboratory, Argonne, Illinois 60439 (US)); Derrick, M.; Kooijman, P.; Musgrave, B.; Price, L. E.; Repond, J.; Sugano, K.; Waschbusch, P.; Blockus, D.; Brabson, B.; and others. *Physical Review [Section] D: Particles and Fields (USA)*, 40(3): 706-711 (1 Aug 1989). DOE Contract W-31-109-ENG-38.

This paper reports cross-section measurements for the ρ^0 and $K^*(890)$ vector mesons produced in e^+e^- annihilation at $\sqrt{s}$ =29 GeV. The data, which were taken with the High Resolution Spectrometer operating at the SLAC colliding-beam facility PEP,correspond to an integrated luminosity of 291 pb^{-1}. The measured multiplicities for fractional momentum x>0.05 are

N_{ρ^0}=0.79±0.04 and $N_{K^{*0}(890)}$=0.53±0.04. The measured fragmentation functions agree well with the predictions of the Lund model and when extrapolated to threshold, the corresponding total multiplicities are N_{ρ^0}=0.90±0.05 and $N_{K^{*0}(890)}$=0.59±0.05.

43816 $W^{\pm}H^{\mp}$ production at hadron colliders. Dicus, D. A. (Center for Particle Theory, University of Texas, Austin, Texas 78712 (US)); Hewett, J. L.; Kao, C.; Rizzo, T. G. *Physical Review [Section] D: Particles and Fields (USA),* 40(3): 787-792 (1 Aug 1989). DOE Contract FG05-85ER40200.

We have examined the production of a charged Higgs boson in association with a *W* boson at high-energy hadron colliders, i.e., $pp \rightarrow W^{\pm}H^{\mp}+X$, and find that the production rates can be large. The various subprocesses which contribute to this mechanism at the tree and one-loop levels are compared and we find that quark annihilation $b\bar{b}, t\bar{t} \rightarrow W^{\pm}H^{\mp}$ is dominant. Production via gluon-gluon fusion, which proceeds through box and triangle diagrams, is also found to yield a significant contribution. We also compare our results with those obtained in rank-5 E_6 models for this process.

43817 Production cross section and topological decay branching fractions of the τ lepton. Abachi, S. (Argonne National Laboratory, Argonne, Illinois 60439 (US)); Derrick, M.; Kooijman, P.; Musgrave, B.; Price, L. E.; Repond, J.; Sugano, K.; Blockus, D.; Brabson, B.; Brom, J.; and others. *Physical Review [Section] D: Particles and Fields (USA),* 40(3): 902-905 (1 Aug 1989). DOE Contract W-31-109-ENG-38.

We report new measurements of the production cross section for the reaction $e^+e^- \rightarrow \tau^+\tau^-$ at $\sqrt{s}$ =29 GeV, as well as the topological decay branching fractions of the τ lepton. The data were taken with the High Resolution Spectrometer at the SLAC e^+e^- colliding-beam facility PEP. The measured cross section yields $R_{\tau\tau}$=1.044±0.014±0.030 [where the first (second) error is statistical (systematic)], consistent with QED and corresponding to QED cutoff parameters of Λ_+>129 GeV and Λ_->284 GeV at the 95% C.L. The fractions of τ decays into one and three charged particles are B_1=0.864±0.003±0.003 and B_3=0.135±0.003±0.003.

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Refer also to citation(s) 43064, 43065, 43804, 43857, 43866, 43867, 43868, 43951, 43958, 43965, 43998

43818 (CONF-8905143–8) **Lattice calculation of dilepton production in peripheral relativistic heavy-ion collisions.** Oberacker, V.E.; Umar, A.S.; Strayer, M.R.; Bottcher, C. Oak Ridge National Lab., TN (USA). [1989]. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From NATO international advanced courses on the nuclear equation of state; Peniscola (Spain); 12 May - 3 jun 1989. Order Number DE89015369/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this talk, I will concentrate on electromagnetic dilepton production in peripheral heavy-ion collisions at relativistic energies. For very heavy systems such as Au + Au,U + U the effective coupling constant $Z\alpha \approx 0.5$, thus casting doubt on the applicability of perturbation theory. We shall therefore utilize a nonperturbative lattice approach. The main problem to be solved is the Dirac equation for leptons in the presence of strong transient EM fields ($E_{max} = 10^{25}$V/m for U + U at RHIC energies). There are several motivations for these studies: We will be able to probe nonperturbative QED in an entirely new energy regime. The hadronic (Drell-Yan) production of dileptons has been widely discussed as a signature of the quark-gluon plasma phase transition. The dominant background will be the coherent EM pair production by the heavy ions in relativistic motion. Lepton pair production with capture of the negatively charged lepton by one of the ions is one of the most serious beam-loss mechanisms for relativistic heavy-ion colliders. 7 refs., 2 figs.

43819 (INFN-LNF–89-013(PT)) **New VDM prediction for time like form factors.** Dubnicka, S.; Etim, E. Istituto Nazionale di Fisica Nucleare, Rome (Italy). 1989. 12p. (CONF-8810407–: Nuclear structure workshop, Frascati (Italy), 27-28 Oct 1988). Order Number DE89632137/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A VMD model which incorporates improved analyticity properties of electromagnetic form factors of hadrons and unitarity corrections is presented. It is applied to the description of the electromagnetic structure of pions, kaons and nucleons. In the case of pions and kaons, contributing higher vector meson resonances are determined from the analysis of the processes $e^+e^- \rightarrow \pi^+\pi^-$ and $e^+e^- \rightarrow$Kaons anti-Kaons, respectively. In the case of nucleons the behaviour of the electric and magnetic form factors of the neutron in the time-like region is predicted.

43820 (INIS-SU–96, pp. 37-38) **On electroweak deep inelastic interaction of polarized leptons with nucleons: phenomenological consideration and model evaluations.** Kukhto, T.V. (Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR)); Pacheko, F. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).

Within the framework of phenomenological approach and in the quark-parton model taking into account electromagnetic and weak interactions the bremsstrahlung contribution into experimental observables during interactions of polarized leptons with polarized nucleons is determined. 2 refs.

43821 (INIS-SU–96, pp. 39-40) **Structure functions and form-factors in processes of polarized lepton electroweak interaction with polarized nucleons.** Kukhto, T.V. (Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR)); Nguen, T.Z.; Shumejko, N.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).

Relations between structure functions and form factors during electroweak interaction of polarized leptons with polarized nucleons are determined. 2 refs.

43822 (INIS-SU–96, pp. 13-14) **Baryon mass spectrum in quark model according to hyperspherical functions method.** Inopin, A.E. (Khar'kovskij Gosudarstvennyj Univ., Kharkov (Ukrainian SSR)); Inopin, E.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).

Within the framework of inspired QCD of a potential quark model the mass spectrum of nonstrange baryon resonances with quantum numbers j^P=1/2$^+$, 3/2$^+$ is measured. The hyperspherical functions method is used in variation problem solution. The calculated masses are in good agreement with the experimental data. 6 refs.; 1 tab.

43823 (INIS-SU–96, pp. 15-17) **Electromagnetic form factors of nucleons and of N-Δ(1236) transition in constituent quark model.** Gagilidze, S.A. (Tbilisskij Gosudarstvennyj Univ., Tbilisi (USSR)); Surovtsev, Yu.S.; Tkebuchava, F.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).

It is shown in the nonrelativistic oscillatory model of constituent quarks with spin-spin interquark forces that taking into account relativistic corrections it is possible to obtain a satisfactory agreement with the experimental data on calculations of Δ(1236) isobar photo- and electro-excitation and electromagnetic form factors of nucleons up to momentum transfer K^2=-1...-2 GeV^2. It is established that the electric neutron structure is mainly formed due to color magnetism contribution. 10 refs.; 2 figs.

43824 (INIS-SU–96, pp. 17-19) **Coupling of generalized magnetic polarizability of hadron and its electromagnetic form factors.** Maksimenko, N.V. (Gomel'skij Gosudarstvennyj Univ., Gomel (Byelorussian SSR)); Shul'ga, S.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).

Amplitude representation of compton scattering on hadron, suitable for low-energy expansion and for determination of the contribution into generalized polarizability of hadron and its electromagnetic form gactors occurred due to taking into account one-particle intermediate state and a state containing an initial hadron and a hadron-antihadron pair, is determined. On the basis of this representation the contribution into generalized magnetic polarizability of pion by its electromagnetic form factor is determined. 2 refs.

43825 (INIS-SU–96, pp. 19-20) **Polarizability of strong-coupling two-particle systems in quasipotential models.** Maksimenko, N.V. (Gomel'skij Gosudarstvennyj Univ., Gomel (Byelorussian SSR)); Shul'ga, S.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).

Within the framework of the Logunov-Tavkhelidze equation for wave function of a system of two scalar quarks in the external electromagnetic field in models with Coulomb and ascillatory quasipotentials electric polarizability of π- and K-mesons is calculated. 3 refs.; 2 figs.

43826 (INIS-SU–96, pp. 21-22) **Radiative decays of vector and pseudoscalar mesons in effective chiral Lagrangian with Wess-Zumino term.** Koval'chuk, V.A. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).

Radiative decay widths for V -> pγ and P -> vγ, where V and P are vector and pseudoscalar meson nonets, are calculated in effective chiral lagrangian with the Wess-Zumino term. The conclusion is made that the considered model satisfactorily describes the experimental data. The slope of conversion decay form factors, such as of ω -> $\pi^0\mu^+\mu^-$, π^0 -> $e^+e^-\gamma$, eta -> $\mu^+\mu^-\gamma$, eta' -> $\mu^+\mu^-\gamma$ decays, predicted by the given model coincides with that of the vector dominancy model. 9 refs.; 1 tab.

43827 (INIS-SU–96, pp. 22-23) **ω -> 3π, phi -> 3π, k* -> k2π decaysin effective chiral lagrangian with Wess-Zumino term.** Koval'chuk, V.A. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).

The effective chiral lagrangian with the Wess-Zumino term is constructed and its predictions for ω -> 3π, phi -> 3π, k* -> k2π decay probabilities are considered. 7 refs.

43828 (INIS-SU–96, pp. 24-25) **Radiative decays of exotic baryons with 3/2 spin.** Kulish, Yu.V. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).

Radiative decays of exotic baryons with J^P=3/2$^-$ from 35-plet of a group of SU(3) aroma representing mixed states of Q^4Q-tilde- and hadron systems are considered. Radiative widths of baryons with 5/2 isospin and zero strangeness are calculated. 5 refs.; 1 tab.

43829 (INIS-SU–96, pp. 26-28) **Λ-hyperon charge radius in quark models.** Romanov, V.A. (Khar'kovskij Gosudarstvennyj Univ., Kharkov (Ukrainian SSR)); Trubnikov, S.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).

The Λ-hyperon charge radius is calculated in the nonrelativistic constituent quarks model and bag model taking into account one-gluon exchange corrections. 10 refs.; 2 tabs.

43830 (INIS-SU–96, pp. 82-83) **Study on the six quark system in nonrelativistic quark model.** Vashakmadze, I.G. (Tbilisskij Gosudarstvennyj Univ., Tbilisi (USSR)); Machabeli, I.Z.; Shavtalishvili, Z.D. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).

The six quark system is studied within the framework of nonrelativistic quark-cluster model. In calculations the quark-quark potential of one-gluon exchange is used and all symmetry types of wave functions are taken into account for excitation quanta N ≤ 2. The importance of all states taken into account is shown, the role of all the potential terms is studied. The addition of L=2 state to the ground one is about 5%. The obtained results slightly depend on the choice of confinement type. 6 refs.

43831 (INIS-SU–102, pp. 58-61) **Possibility of studying CP invariance violation in decays of B mesons produced by photons in a steady target of UNK.** Bajshev, I.S.; Govorkov, A.B.; Govorkov, B.B. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89012199/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 9.

It is shown that photoproduction of beaty mesons in a steady target of UNK provides particle production rate sufficient for setting up experiments on checking CP invariance violation in B meson decays. 14 refs.; 3 figs.; 1 tab.

43832 (INIS-SU–102, pp. 34-35) **Extrapolation of the kaon-nucleon amplitude to the Cheng-Dashen point.** Efrosinin, V.P. (AN SSSR, Moscow (USSR). Inst. Yadernykh Issledovanij); Zaikin, D.A.; Osipchuk, I.I. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89012199/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 9.

The extrapolation procedure for isosymmetrical πN amplitude to the Cheng-Dashen point in the Breit system is discussed. The features of such a procedure for the kaon-nucleon amplitude are shown. The kaon-nucleon σ term $\sigma_{K\pm n}{}^{+}(t=2m_K{}^2)$ is estimated. 10 refs.

43833 (INIS-SU–102, pp. 43-45) **Physical QCD_2.** Saradzhev, F.M. (Azerbajdzhanskij Gosudarstvennyj Univ., Baku (USSR)). AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89012199/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 9.

Two-dmensional QCD on physical vector states is built. QCD_2 is considered in gauging A_0=0. This gauging does not fix gauge invariance completely. The vectors meeting the Gauss law are physical ones. Canonical formalism is used and relations are solved in two stages. The first stage is transformation to nonconverted fermions. At the second stage it is shown how to complete solution of relations and construct the physical hamiltonian. Physical QCD_2 is reduced to fermion fields interacting with chiral currents. 6 refs.

43834 (INIS-SU–103/A, pp. 40-42) **π^0->2γ decay width and chiral symmetry dynamical breaking in QCD.** Maglaperidze, T.I.; Tkebuchava, F.G. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Quantum radiophysics. Collection.* Order Number DE89012203/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 12.

It is shown that in frames of chiral symmetry breaking in QCD the π^0->2γ decay width much depends on quark propagator form in nonasymptotic region of Euclidean four-momenta. π^0-meson decay width is calculated on the basis of triangular quark diagram taking into account nonlocal character of π^0-meson field Yukawa vertex. 7 refs.; 1 fig.

43835 (INIS-SU–103/A, pp. 46-48) **Quantum mechanics modelling of quarkonium and superatoms.** Khvingiya, N.L. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Quantum radiophysics. Collection.* Order Number DE89012203/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 12.

In quasi-accurately-solved quantum-mechanical models with smooth step-like potential conclusions on the effect of different potential modifications on quarkonium and superatom spectra are made. For asymptotically free potential without containment 1D level is always above 2S, and the level sequence in phase transition r_0<0.12fm is the following: 1S,2S,1P,1D. At r_0>0.12 fm configuration is changed: 1S,1P,2S,1D. In case of toponium the level location points to role and position of the jump in interquark potential. In case of superatoms, at $r_0$2.1A (r_0-core radius) Coulomb degeneration takes place, and with further r_0 growth (from 2.3 to 180A) the level configuration sequence is 1S,1P,1D,2S. These regularities point to the ways of controlling zone structure of superatomic complexes. 8 refs.; 1 fig.

43836 (INS–741) **Pion-transfer reaction spectroscopy for deeply bound π^- states.** Yamazaki, Toshimitsu. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Mar 1989. 9p. Order Number DE89906507/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

A new type of spectroscopy using pion-transfer (n,p) and other charge-exchange reactions to study deeply bound π^- states in heavy nuclei is described. First, a general framework of Coulomb-assisted hybrid bound states is discussed, and structure of heavy π^- atoms is predicted. Then, π^- transfer reactions are theoretically studied, and current and future experimental possibilities are discussed. (author).

43837 (IYF–88-121) **On the Σ^*- and γ^*-hyperons wave functions.** Ogloblin, A.A. AN SSSR, Novosibirsk (USSR). Inst. Yadernoj Fiziki. 1988. 24p. Order Number DE89634577/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The properties of the leading twist wave functions of the Σ+(1385) and γ+(1530)-hyperons are invesigated using the QCD sum rules. the model wave functions which satsfy the sum requirements are proposed. The asymptotic behaviour of Σ^*- and $\gamma\pm$hyperons electromagnetic formfactors and that of various octet-decuplet transition formfactors is found. 11 refs.; 8 tabs.

43838 (JINR-E–2-88-487) **Low-energy limit of a bilocal meson Lagrangian from QCD.** Kalinovskij, Yu.L.; Kaschluhn, L.; Pervushin, V.N. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 14p. Order Number DE89634578/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to Z. Phys., C.

The low-energy limit of the Bethe-Salpeter equation with a relativistic kernel for quark-antiquark bound states is considered. It is shown that this limit as equivalent to a localization of the potential which becomes a special 4-quark Nambu-Jona-Lasinio one. The mass spectrum of the low-lying mesons is calculated without expanding in energy. Thereby the S-V, P-A and V-T mixings are taken into account exactly. Furthermore the pion decay constant is determined. We received good agreement with the experimental data. 11 refs.; 1 fig.; 3 tabs.; submitted to Z. Phys., C.

43839 (LBL–27234) **Space-time aspects of hadronic cascading in lepton nucleus scattering.** Gyulassy, M.; Pluemer, M. Lawrence Berkeley Lab., CA (USA). May 1989. 23p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8901115–4: Topical conference on electronuclear physics with internal targets, Stanford, CA (USA), 9-12 Jan 1989). Order Number DE89015228/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A Monte Carlo model of hadronic cascading in inelastic lepton nucleus scattering is constructed to investigate space-time scenarios consistent with the momentum space description of string models of multiparticle production. The prospects for resolving the ambiguity inherent in the definition of a formation length for composite hadrons are emphasized. 15 refs., 13 figs.

43840 (LBL–27481) **The electromagnetic penguin contribution to ϵ'/ϵ for large top quark mass.** Randall, L. Lawrence Berkeley Lab., CA (USA). 12 Jul 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8904226–6: 12. international workshop on weak interactions and neutrinos, 9-14 Apr 1989). Order Number DE89016304/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We investigate the electromagnetic penguin contribution to ϵ'/ϵ when the top quark mass is large. We find it depends sensitively on the top quark mass. 6 refs., 2 figs.

43841 (RAL–89-036) **Remarks about top quark signals at pp-bar colliders.** Phillips, R.J.N. Rutherford Appleton Lab., Chilton (UK). May 1989. 6p. Order Number DE89634579/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Conventional top signals at pp-bar colliders are based on leptons from semileptonic top decays t -> bl4u. Three aspects are briefly discussed. (i) Lepton isolation is the usual way to suppress backgrounds from b and c decays, but the unknown b -> u decays are more difficult to suppress than b -> c; also theoretical and experimental isolation do not always correspond. (ii) W -> l4u decay is the principal remaining background; there are new ways to separate top signals that exploit the associated jet multiplicity, or dileptons, or both. (iii) If conventional decays via real charged Higgs scalars t to bH+ occur, they could suppress conventional modes; however the subsequent decay H+ -> tau-bar4u plausibly has a big branching fraction and could generate observable signals (events with large missing P_T, isolated tau-jet or lepton, two isolated tau-jets) at present pp colliders. (Author).

43842 (SLAC-PUB–5003) **Effects of charged Higgs in τ decay.** Tsai, Yung Su. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8905144–3: Tau-Charm workshop, Stanford, CA (USA), 23-27 May 1989). Order Number DE89013982/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An experiment to test the effect of charged Higgs exchange in τ decay is proposed. It is pointed out that in the decay $\tau^- \to \nu_\tau + \pi^-$

+ π^0 the effect due to Higgs exchange can be obtained by observing the angular distribution of the π^- in the rest frame of the $\pi^- + \pi^0$. For each value of invariant mass of the $\pi^- + \pi^0$ system, the π^- must have a unique p-wave angular distribution independent of the strong interaction if it is due to W^- exchange alone. Any s-wave interference with this p-wave angular distribution can be attributed to the scalar exchange. 9 refs., 1 fig.

43843 Quark core stars, quark stars and strange stars. Grassi, F. (Fermi National Accelerator Lab., Batavia, IL (USA)). *Zeitschrift fuer Physik [Sektion] C: Particles and Fields (F.R. Germany),* 44(1): 129-138 (Sep 1989).

A recent one flavor (zero temperature) quark matter equation of state is generalized to several flavors. It is shown that quarks undergo a first order phase transition. In addition, this equation of state depends on few parameters, one in the two flavor case, two in the three flavor case, and these parameters can be constrained by phenomenology. This equation of state is then applied to (1) the hadron-quark transition in neutron stars and the determination of quark star stability, (2) the investigation of strange matter stability and possible strange star existence. (orig.).

43844 Spectra of strings on nonsimply-connected group manifolds. Ahn, C. (Stanford Linear Accelerator Center, CA (USA)); Walton, M.A. *Physics Letters [Section] B (Netherlands),* 223(3/4): 343-348 (15 Jun 1989). DOE Contract AC03-76SF00515.

We use the orbifold approach to conform the formula of Felder, Gawedski and Kupiainen for the one-loop partition function of strings on nonsimply-connected group manifolds. (orig.).

43845 The $K_S^0K_S^0\pi^0$ system produced in π^-p interactions at 21.4 GeV/c. Rath, M. G. (University of Notre Dame, Notre Dame, Indiana 46556 (US)—Brandeis University, Waltham, Massachusetts 02254 Brookhaven National Laboratory, Upton, New York 11973—Brookhaven National Laboratory, Upton, New York 11973 (US)); Cason, N. M.; Bensin *Physical Review [Section] D: Particles and Fields (USA),* 40(3): 693-705 (1 Aug 1989). DOE Contract AC03-76SF00098.

The $K_S^0K_S^0\pi^0$ systems, a pure C=+1 state, has been studied in the reaction $\pi^-p\rightarrow K_S^0K_S^0\pi^0n$ at 21.4GeV/c. The $K_S^0K_S^0\pi^0$ spectrum is significantly different from the $\bar{K}K\pi$ distribution observed in other lower-energy peripheral hadroproduction experiments. In addition to production of the $f_1(1285)$, evidence for production of the $\eta(1460)$ [sometimes called the $\iota(1460)$] based on mass spectra and a Dalitz-plot spin-parity analysis is reported. The narrower, lower-mass state observed in other $\bar{K}K\pi$ experiments is observed weakly if at all in this experiment. Hadronic production of the $\eta(1460)$, which is a good glueball candidate because of its presence in J/ψ radiative decay, suggests possible mixing with the $\bar{q}q$ sector.

43846 Exotic-quark production at e^+e^- colliders. Rizzo, T. G. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706 (US)— Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011 (US)). *Physical Review [Section] D: Particles and Fields (USA),* 40(3): 754-759 (1 Aug 1989). DOE Contract AC02-76ER00881.

The prospects for discovering exotic quarks (h), present in E_6 models, at existing and future high-energy e^+e^- colliders are examined. The flavor-changing decay mode, $h\rightarrow$jet+l^+l^-, clearly separates the production of h from that of new sequential quarks. Although this mode has a small branching fraction, reasonable event rates at each of the various colliders is expected.

43847 Production of neutral bosons by an electron beam. Tsai, Y. S. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309 (US)). *Physical Review [Section] D: Particles and Fields (USA),* 40(3): 760-768 (1 Aug 1989). DOE Contract AC03-76SF00515.

We investigate the possible existence of neutral bosons which are coupled to leptons. The cross section for the process $e+p\rightarrow e+X+$anything, where X is a neutral boson of spin-parity $0^\pm$ of $1^\pm$ emitted by the electron, is calculated and its energy-angle distribution discussed. Assuming X to decay predominantly into a lepton pair we investigate the characteristics of the background. It is pointed out that the signal-to-background ratio can be greatly enhanced if one selects high $x=E_X/E_1$ and also uses the outgoing electron as a tag at a slightly nonforward angle with the X particle arranged in such a way that the momentum transfer to the target particle is near its minimum. This happens when the outgoing electron momentum $\mathbf{P}_2$ is parallel to $\mathbf{P}_1-\mathbf{k}$, where $\mathbf{P}_1$ and $\mathbf{k}$ are the momenta of the incident electron and the X particle, respectively.

43848 Probing gluon polarization in hadronic direct photon production. Berger, E. L. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439 (US)); Qiu, J. *Physical Review [Section] D: Particles and Fields (USA),* 40(3): 778-786 (1 Aug 1989). DOE Contract W-31-109-ENG-38.

Inclusive direct photon production at large transverse momentum in proton-proton interactions with a longitudinally polarized beam and target is an incisive probe of the polarized gluon density in a proton. To help motivate future experiments and assist in their design, we provide predictions of the polarization asymmetry for a range of reasonable choices of the polarized gluon density. The cross sections are small at fixed-target energies, but the effort to measure them is necessary if the polarized gluon density $\Delta G(x,Q^2)$ is to be determined. In order to obtain our predictions, we parametrize spin-dependent parton densities and compute their evolution with Q^2. Our densities provide good agreement with the spin-dependent structure function $g_1^p(x,Q^2)$ measured in deep-inelastic lepton scattering.

43849 Exclusive semileptonic decays of B and D mesons. Cline, J. M. (Department of Physics, The Ohio State University, Columbus, Ohio 43210 (DE)); Palmer, W. F.; Kramer, G. *Physical Review [Section] D: Particles and Fields (USA),* 40(3): 793-805 (1 Aug 1989).

Exclusive semileptonic decays of D and B mesons to one and two pseudoscalar mesons are studied with respect to form-factor dependence, finite-width effects in intermediate resonant states, and nonresonant background terms calculated from chiral Lagrangians. Branching ratios, electron decay spectra, and asymmetry parameters for angular distributions are given for Cabibbo-Kobayashi-Maskawa-favored and -unfavored transitions, and compared to experimental data.

43850 Exploration of the limits on charged-lepton-specific forces. Hawkins, C. A. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309 (US)); Perl, M. L. *Physical Review [Section] D: Particles and Fields (USA),* 40(3): 823-832 (1 Aug 1989). DOE Contract AC03-76SF00515.

This paper explores the present experimental limits on the existence of a hypothetical force which would only couple to charged leptons; the neutral particle carrying the force having a mass greater than several MeV/c^2. We consider limits from data on $g_e-2, g_\mu-2$, electron beam-dump experiments, $e^+e^-\rightarrow e^+e^-$, $e^+e^-\rightarrow\mu^+\mu^-$, and $e^+e^-\rightarrow\tau^+\tau^-$. Our purpose is to provide a basis for design of future experiments which would be more sensitive to the existence of a charged-lepton-specific force or other unknown phenomena connected to charged leptons.

43851 Relativistic description of quark-antiquark bound states. Spin-independent treatment. Gara, A. (Department of Physics, University of Wisconsin-Madison, Madison, Wisconsin 53706 (US)); Durand, B.; Durand, L.; Nickisch, L. J. *Physical Review [Section] D: Particles and Fields (USA),* 40(3): 843-854 (1 Aug 1989).

We present the results of a detailed study of light- and heavy-quark–antiquark bound states in the context of the reduced Bethe-Salpeter equation with static vector and scalar interactions. In the present paper, we consider the spin-averaged spectra. Spin effects are considered in a separate paper. We find that this approach, although apparently successful for the heavy-quark $\bar{b}b$ and $\bar{c}c$ states, fails for the $\bar{s}s$, $\bar{l}l$, and light-heavy states. The reasons for the failure are intrinsic to the method, as we discuss. Difficulties are already evident for the $\bar{c}c$ states.

43852 Neutron-proton mass-splitting puzzle in Skyrme and chiral quark models. Jain, P. (Center for Theoretical Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139 (US)); Johnson, R.; Park, N. W.; Schechter, J.; Weigel, H. *Physical Review [Section] D: Particles and Fields (USA),* 40(3): 855-865 (1 Aug 1989).

The nonelectromagnetic part of the *n-p* mass difference is known to vanish in the Skyrme model of pions. This result is shown to hold when the model is extended to include an isoscalar 0^- field. However the inclusion of vector mesons to describe "short-distance" effects enables the isoscalar 0^- field to contribute and this explains most of the *n-p* splitting in a two-flavor model. To carry out the analysis we make a detailed study of chiral-symmetry breaking in the pseudoscalar-vector Lagrangian. The contribution due to the strange constituents of the nucleon is also estimated. The sum of the two contributions is shown to be sufficient to explain the experimental number. Another way to discuss "short distance" effects is the explicit inclusion of quark degrees of freedom via the "chiral quark model." We show that this can also give rise to nonzero *n-p* splitting.

43853 Pion fluctuations around a moving and rotating Skyrmion. Liu, H. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104 (DE)); Oka, M. *Physical Review [Section] D: Particles and Fields (USA)*, 40(3): 883-889 (1 Aug 1989).

Fluctuating pion fields around a moving and rotating Skyrmion are quantized by Dirac's method. Both the rotational and translational collective motion of the Skyrmion are described by collective coordinates and then all six zero-frequency modes of the pion field are eliminated. The method allows us to treat fluctuations around a soliton consistently with its collective rotational and translational motion. Pion-baryon linear couplings are studied and the $\Delta \rightarrow N\pi$ decay rate is calculated.

43854 High-p_T *W* and *Z* production at the Fermilab Tevatron. Arnold, P. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439 (US)); Ellis, R. K.; Reno, M. H. *Physical Review [Section] D: Particles and Fields (USA)*, 40(3): 912-913 (1 Aug 1989).

In previous work, we and others have put together a full computation of $d\sigma/dq_T$ for the inclusive production of high-transverse-momentum *W*s and *Z*s to second order in QCD. Here, we present the results in graphs from which relevant cross sections may be extracted at a glance. Specifically, we plot $d\sigma/dq_T$ and $\int_{q_T} dq_T (d\sigma/dq_T)$ for the Fermilab Tevatron.

6453 Particle Invariance Principles and Symmetries

Refer also to citation(s) 43732, 43816, 43849, 43853, 43869

43855 *CP* violation in models with chiral color. He, X. (Research Center for High Energy Physics, School of Physics, University of Melbourne, Parkville, Victoria 3052, Australia (AT)); Rajpoot, S. *Physical Review Letters (USA)*, 63(5): 486-489 (31 Jul 1989).

We study *CP* violation in a chiral color model with exotic fermions transforming as singlets of the weak-isospin group $SU(2)_L$. The Higgs sector consists of a nonet of chiral color and the usual doublet of $SU(2)_L \times U(1)_Y$. In the limit in which the mixings between the third generation with the first two generations are small, *CP*-violating interactions are dominated by the exchange of neutral Higgs bosons. The *CP*-violating parameters ϵ and ϵ'/ϵ for the kaon system are easily accommodated. The neutron electric dipole moment is generated at the one-loop level and is $\sim 10^{-25}$–10^{-26} e cm.

43856 Strong *CP* violation and the neutron electric dipole moment. Liu, J. (Randall Laboratory of Physics, University of Michigan, Ann Arbor, Michigan 48109 (US)); Geng, C. Q.; Ng, J. N. *Physical Review Letters (USA)*, 63(6): 589-592 (7 Aug 1989).

We derive an identity that relates the fermion electric dipole moment from weak *CP*-violation effects to the strong *CP* parameter θ. In the absence of Peccei-Quinn-type symmetries, we find that requiring θ naturally small generally implies that, for a large class of models, the dominant contribution to the neutron electric dipole moment d_n comes from strong *CP* violation rather than directly from weak *CP*-violation effects.

43857 *CP*-violation phase hierarchy and minimal left-right models. Liu, J. (Randall Laboratory of Physics, University of Michigan, Ann Arbor, Michigan 48109 (US)). *Physical Review [Section] D: Particles and Fields (USA)*, 40(3): 914-917 (1 Aug 1989).

We discuss *CP* violation in a class of minimal left-right models. It is shown that an interesting phase hierarchy arises if, in an appropriate basis, the quark masses have a nontrivial relative sign. With such a phase hierarchy, we find that, even in the small-phase approximation, ϵ'/ϵ and the neutron electric dipole moment d_n can, respectively, be of the order 3×10^{-3} and 10^{-25} *e* cm with either sign.

6454 Field Theory

Refer also to citation(s) 43846, 43848, 43849, 43851, 43853, 44180

43858 (BiBoS–353/89) **Quantum fields on a Riemann surface.** Haba, Z. Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS). 1989. 32p. Available from Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS).

We generalize the notion of Osterwalder-Schrader (OS) positivity to Euclidean field theory on Riemann surfaces. We prove that some bosonic and fermionic Euclidean free fields defined on a symmetric Riemann surface fulfill the reflection positivity. We show that the Hilbert space constructed by means of the reflection positive correlation functions coincides with the Fock space determined by quantum fields defined on the reflection invariant curves. The uniformization theorem allows to express the fields on a Riemann surface in terms of the free fields defined on the plane. (orig.).

43859 (BiBoS–358/89) **A global and stochastic analysis approach to bosonic strings and associated quantum fields.** Albeverio, S.; Hoeegh-Krohn, R.; Paycha, S.; Scarlatti, S. Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS). 1989. 90p. Available from Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS).

We construct a probability measure giving a mathematical realization of Polyakov's heuristic measure for bosonic strings in space-time dimensions $3 << d << 13$, having as world sheet compact Riemann surfaces Λ of arbitrary genus. The measure involves the path space measures for scalar fields with exponential interaction on Λ and a measure on Teichmueller space. (orig.).

43860 (BiBoS–360/87) **White noise analysis and quantum field theory.** Streit, L. Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS). 1987. 16p. Available from Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS).

The author shows that the energy form for the Hamiltonian of a canonical quantum field theory in terms of the ground-state density is equivalent to a white-noise functional. (HSI).

43861 (IN2P3–89-01) **Strings and superstrings. Electron linear colliders.** Alessandrini, V.; Bambade, P.; Binetruy, P.; Kounnas, C.; Le Duff, J.; Schwimmer, A. Institut National de Physique Nucleaire et de Physique des Particules, 75 - Paris (France). 1989. 283p. (In French). (CONF-8709294–: 19. Ecole de Physique des Particules (Gif-sur-Yvette summer school of Particle Physics), Marseille-Luminy (France), 7-11 Sep 1987). Order Number DE89903207/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

Basic string theory; strings in interaction; construction of strings and superstrings in arbitrary space-time dimensions; compactification and phenomenology; linear e+e- colliders; and the Stanford linear collider were discussed.

43862 (INIS-SU–98, pp. 154) **On the role of a direct atomic knock out mechanism in polycrystal sputtering by heavy ions.** Shul'ga, V.I.; Ehl'tekova, D.V. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

Short note; 2 refs.

43863 (INIS-SU–102, pp. 10-11) **Weyl lattice fermions.** Zenkin, S.V. (AN SSSR, Moscow (USSR). Inst. Yadernykh Issledovanij). AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89012199/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 9.

A new type of fermion action on a lattice meeting functional integrals in symmetric (Weyl) quantization is found. The action is nonlocal and in the massless limit it is chirally invariant, i.e. it extends to Weyl (two-component) fermions. 9 refs.

43864 (JINR-E–2-88-557) **Nonlocality and stochastic quantization of field theory.** Dineykhan, M.; Namsrai, Kh. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 52p. Order Number DE89633913/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Submitted to the journal Intern. J. Theor. Phys.

Concept of nonlocality is introduced into physics by means of stochastic context using Langevin and Schwinger-Dyson techniques. This allows as to reformulate finite theory of quantum field, free from ultraviolet divergences, based on the stochastic quantization method with nonlocal regulators. As a nonlocal regulator we choose any entire analytic function in the momentum space, which guarantees that our regularization method for any theory of interest does not violate basic physical principles such as unitarity, causality, and gauge invariance of the theory. Here we present regularization scheme for scalar, gauge and scalar electrodynamics theories. 31 refs.; 19 figs.; 2 tabs.; submitted to the journal Intern. J. Theor. Phys.

43865 Infinite-dimensional algebras, sine brackets, and SU(∞). Fairlie, D.B. (Durham Univ. (UK). Centre for Particle Theory); Zachos, C.K. *Physics Letters [Section] B (Netherlands),* 224(1/2): 101-107 (23 Jun 1989). DOE Contract W-31-109-ENG-38.

We investigate features of the infinite dimensional algebras we have previously introduced, which involve trigonometric functions in their structure constants. We find a realization for them which leads to a basis-independent formulation. A special family of them, the cyclotomic ones, contain SU(N) as invariant subalgebras. In this basis, it is evident by inspection that the algebra of SU(∞) is equivalent to the centerless algebra of $SDiff_0$ on two-dimensional manifolds. Gauge theories of SU(∞) are thus simply reformulated in terms of surface coordinates. (orig.).

43866 Constraints for conformal field theories on the plane: Reviving the conformal bootstrap. Lewellen, D.C. (Stanford Linear Accelerator Center, CA (USA)). *Nuclear Physics [Section] B (Netherlands),* 320(2): 345-376 (3 Jul 1989). DOE Contract AC03-76SF00515.

We obtain a number of results by reexamining conformal field theory on the plane, using only elementary mathematics in the process. In particular we rederive the constraints on conformal dimensions found by Vafa, using the crossing symmetry of four-point amplitudes; find stronger, inequality versions of these conditions which constrain the magnitude of the conformal dimensions of primary fields which can appear as intermediate states in a given amplitude; and study the conformal bootstrap perturbatively using the power-series expansions for conformal block functions. This latter approach gives constraints of a quite different type, in particular tree-level constraints on the central charge. (orig.).

43867 Conformal field theory and a topological quantum theory of vortices and knots. Chapline, G. (Lawrence Livermore National Lab., CA (USA)); Grossman, B. *Physics Letters [Section] B (Netherlands),* 223(3/4): 336-342 (15 Jun 1989). DOE Contract W-7405-ENG-48.

We examine the two-dimensional quantum field theory with topological action Tr $\int d^2\text{chi}\ \epsilon^{ij}(1/4F_{ij}[PHI^*, PHI]-D_iPHI^*D_jPHI)$. In the semi-classical limit the action will be dominated by self-dual vortices associated with singularities in the reduction of a four-dimensional topological theory to a Riemann surface. We propose that the creation operators for these vortices can be identified with the primary fields of a current algebra, and this leads to fractional statistics for the vortices. Expressing the Berry phase associated with unwinding a knot in terms of the phase for exchanging two vortices then provides a link between conformal field theory and the Donaldson theory of four-manifolds. If self-duality is imposed as a gauge condition, the low-temperature limit of the theory resembles the world-sheet action for a superstring. (orig.).

43868 Topological invariants and a gauge theory of the super-Poincare algebra in three dimensions. Brooks, R. (Stanford Linear Accelerator Center, CA (USA)). *Nuclear Physics [Section] B (Netherlands),* 320(2): 440-460 (3 Jul 1989). DOE Contract AC03-76SF00515.

Various aspects of superspace topology and N = 1 supersymmetry in 2 + 1 dimensions are explored. Non-minimal super Yang-Mills theory is used to construct a gauge theory of the N = 1 super-Poincare algebra. A topological Yang-Mills theory is given and used to compute elements of the cohomology classes of super-monopole moduli space. (orig.).

43869 Instantons and chiral Lagrangian. Choi, K. (Department of Physics, Carnegie Mellon University, Pittsburgh, Pennsylvania 15213 (US)); Kim, C. W. *Physical Review [Section] D: Particles and Fields (USA),* 40(3): 890-901 (1 Aug 1989).

We derive the chiral Lagrangian including instanton corrections in a consistent way. *CP* violation associated with the θ term in QCD is discussed in terms of this chiral Lagrangian. A particular emphasis is given to a phenomenological determination of m_u and θ. It is shown that, contrary to the previous conclusion that $m_u=0.56m_d$ and $\theta=0$, all three distinct cases (i) $0.56\geq m_u/m_d>0, \theta=0$, (ii) $m_u=0$, (iii) $0.56\geq m_u/m_d>0, \theta=\pi$ are phenomenologically acceptable depending on the strength of the instanton corrections. In cases (i) and (iii), the ratio m_u/m_d can be much smaller than the usually quoted value 0.56. As a result, the models of spontaneous *CP* violation which predict $|\theta|\gg 10^{-9}$ can be phenomenologically viable. Also in the axion models, because of the possibility of m_u/m_d being arbitrarily small, the cosmological upper bound on the axion decay constant can be relaxed.

43870 The delta expansion in zero dimensions. Cho, H. T. (Department of Physics and Astronomy, The University of Oklahoma, Norman, Oklahoma 73019 and Department of Physics, The Ohio State University, Columbus, Ohio 43210 (US)); Milton, K. A.; Pinsky, S. S.; Simmons, L. M., Jr. *Journal of Mathematical Physics (New York) (USA),* 30(9): 2143-2150 (Sep 1989).

The recently introduced δ-expansion (or logarithmic-expansion) technique for obtaining nonperturbative information about quantum field theories is reviewed in the zero-dimensional context. There, it is easy to study questions of analytic continuation that arise in the construction of the Feynman rules that generate the δ series. It is found that for six- and higher-point Green's functions, a cancellation occurs among the most divergent terms, and that divergences that arise from summing over an infinite number of internal lines are illusory. The numerical accuracy is studied in some detail: The δ series converges inside a circle of radius one for positive bare mass squared, and diverges if the bare mass squared is negative, but in all cases, low-order Pade approximants are extremely accurate. These general features are expected to hold in higher dimensions, such as four.

43871 Field theory of geometric *p*-branes. Ho, C. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455 (US)). *Journal of Mathematical Physics (New York) (USA),* 30(9): 2168-2176 (Sep 1989).

In this paper, *p*-brane field theory is constructed in terms of functions of geometric *p*-surfaces. Nambu–Goto *p*-brane dynamics is incorporated in the Dirac form. The field equation for toroidal *p*-branes in *p*+2 dimensions is exactly solved for, and is shown to admit an equally spaced mass-squared spectrum containing massless states.

65 PHYSICS II

Refer also to citation(s) 42242, 43705, 43706, 43707

43872 (INIS-mf–11503) **Annual Meeting 1989.** Transactions. V. 15. Israel Nuclear Society, Yavne (Israel). Mar 1989. 142p.

(CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

Separate papers is these proceedings are indexed separately.

6510 Nuclear Physics

Refer also to citation(s) 43205, 43207, 43989

43873 (DOE/ER/10420–9) **Fusion measurements in light and medium mass heavy-ion reactions: Final report, June 1, 1979–May 31, 1989.** Prosser, F.W. Kansas Univ., Lawrence, KS (USA). Jun 1989. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-79ER10420. Order Number DE89016088/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A description of the various experiments and projects carried out during the period of this contract is given, together with references to all publications which have resulted from it to date. References are also given to contributed papers which contain results which have not yet been published or submitted. Most of the experiments were done at Argonne National Laboratory and cover the period from the first use of a superconducting linear accelerator with the tandem Van de Graaff to the use of ATLAS. A number of experiments were also done at the University of Notre Dame tandem facility and one at the Indiana Cyclotron Facility. A list of graduate and undergraduate students is given, as is a summary of support from the Department of Energy and the University of Kansas. 30 refs.

43874 (DOE/ER/40309–11) **Nuclear structure at intermediate energies: Progress report, January 1–December 31, 1989.** Bonner, B.E.; Mutchler, G.S. Rice Univ., Houston, TX (USA). Dept. of Physics. 31 Jul 1989. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-87ER40309. Order Number DE89016155/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper discusses the following topics: Σ^0C Spin Transfer Experiment; Strangeness Production in Heavy Ion Collisions; Search for a J^{PC} Exotic Hybrid Meson; Antiproton-Nucleus Interactions; Single Pion Production in np Scattering; Two-and Three-Spin Measurements in pp-pp; Proton-Deuteron Elastic Scattering at 800 MeV Two- and Three-Spin Observables; pp Elastic Absolute Cross-Section Measurements; Single Pion Production in np Scattering; Photojets from Nuclei; CCD Development; Computer Acquisition and Computer Software.

43875 (DOE/ER/40390–3) **Experiments on the nuclear interactions of pions and electrons: Progress report.** Minehart, R.C.; Ziock, K.O.H. Virginia Univ., Charlottesville, VA (USA). Dept. of Physics. Jul 1989. 23p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER40390. Order Number DE89016662/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have completed the analysis of the ^{3}He(π^+,pp)n reaction, and are working on the analysis of data for the ^{3}He(π^-,pn)p reaction. An experiment to study the $\pi + d \rightarrow 2p$ reaction at LAMPF was successful in studying incident pion energies as low as 6 MeV. Preliminary results have been reported, and work is continuing to improve the accuracy in the calculation of the fraction of pions in the incident beam. A proposal has been accepted by LAMPF for a new experiment, scheduled to run in the summer of 1990, to study pion absorption in ^{3}He and ^{4}He using an extensive scintillator time-of-flight system capable of detecting neutrons as well as charged particles. We are continuing to analyze data obtained in PSI in the search for the admixture of massive neutrinos in pion decay and have continued the search for fractionally charged particles. We are also fully involved in some major collaborations: the search for the decay $\mu^+ \rightarrow e^+ + \gamma$, and the study of anti-proton absorption in heavy nuclei. We are taking part in a U.Va.-PSI collaboration to measure pion beta decay to an accuracy of about 1%, using a large acceptance CsI detector to measure the π^0 following decay of stopped π^+ mesons. We have also been working on experiments to study electron scattering, using the SLAC-NPAS facility for nuclear physics and the electron accelerator at SACLAY in France. Data from experiment NE-9 at SLAC are being analyzed. This experiment, which was run near the end of 1987, is intended to separate the transverse and longitudinal cross sections for inclusive electron scattering in the QFS region. Experiment NE-8 measured the cross section for photo-disintegration of the deuteron in the GeV range. Some design work was carried out this year on Experiment NE-16 at SLAC, a study of the (e,e'p) reaction in ^{4}He, expected to run late in 1990.

43876 (INIS-mf–11503, pp. 45-50) **Neutron spectra measurement in lead due 14.7 MeV neutrons interaction.** Shani, G. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering); Aruchas, E. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Summary only.

43877 (INIS-SU–78, pp. 232-236) **Neutron spectroscopy of radioctive nuclei by means of the (n,p) reaction.** Gledenov, Yu.M. (Joint Inst. for Nuclear Research, Dubna (USSR)); Zvarova, T.S.; Mitrikov, M.P.; Mitrikova, P.S.; Popov, Yu.P.; Salatskij, V.I.; Fung Van Zuan. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The results of the last measurements of the (n,p) reaction on the radioactive nuclei ^{7}Be, ^{36}Cl and ^{88}Y, performed at the pulsed reactor IBR-30, LNP, JINR, are reported. 13 refs.; 2 figs.; 2tabs.

43878 (INIS-SU–100) **Problems of precision in nuclear spectroscopy. Collection of materials.** AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. 177p. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Individual materials in this collection are separately indexed.

43879 (INIS-SU–100, pp. 143-145) **Application limits for the moments method at the doublets expansion.** Gopych, P.M. (Khar'kovskij Gosudarstvennyj Univ., Kharkov (Ukrainian SSR)); Minko, O.K.; Chkalov, A.I. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The empirical formulae determining the boundaries of the moments method applicability and its precision during dublet decomposition into composing single peaks are obtained and presented. 2 refs.; 1 fig.

43880 (INIS-SU–100, pp. 167-173) **Program for the gamma-spectroscopic experiments, requiring high precision of the measurements.** Davydov, A.V. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The program presented includes the following experiments: 1. Search of combined electron-nuclear atom radiation after K-capture. 2.Search of X-radiation following K-capture and corresponding to the electron configurations of the mother atom. 3.Observation of nuclear excitation accompanying the birth of electron-positron couples by gamma quanta in the nuclear field. 4.Gamma quanta scattering by coupled electrons in the superconductor. 5.Temperature effect on the half-life of nuclei decaying by electron capture or converted gamma-transitions. 6.Research of decay of radioactive and excited atomic nuclei without electron shells. 6 refs.

43881 (INP–1302/PS, pp. 199-217) **Neutron-rich nuclei produced in multi-nucleon transfer with heavy ions; astrophysical**

relevance of the new results. Schmidt-Ott, W.D. (Goettingen Univ. (Germany, F.R.)). Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

Multi-nucleon transfer reactions were used for the production of new isotopes in regions of neutron-rich actinides, lanthanides and particularly of neutron-rich iron, cobalt and nickel isotopes. Decay properties as radioactive half-lives, beta and gamma decay were measured and decay schemes constructed. Additional spectroscopic information was also collected for already known neutron-rich isotopes. Emphasis is placed on applications of our nuclear-physics results to the nucleogenesis. 38 refs., 9 figs. (author).

43882 (INS–707) **Production of nuclear fragments in high-energy nuclear collisions.** Sano, M. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1988. 26p. Order Number DE89906566/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report reviews the systematics of experimental data for projectile fragmentations and related theories, and analyzes the momentum distributions of lithium-9 produced by the projectile fragmentation of exotic nucleus lithium-11. In addition, the coalescence model is reviewed and applied to the estimation of the formation probabilities for exotic nuclear species such as hypernuclei, mesonic atoms and H-particles. It has been considered that in the peripheral collisions the detected fragmentation F comes out of the parent nucleus A as a spectator without scattering with nucleons in the other nucleus B. In the present report, it is shown that a process of collisions of the fragment F with the nucleus B is also important. It is seen that contributions of both processes appear separately in the momentum distributions of lithium-9 produced by the fragmentation of lithium-11. Then, the coalescence model is outlined and an equation is derived which expresses the formation cross section of a composite particle. A similar procedure can be used to derive a general expression for the formation cross section of a nuclear fragment with Z protons and N neutrons. (N.K.).

43883 (INS–722) **Medium-energy spectrometer (PIK) and study of Λ hypernuclei via (π^+, K^+) reactions.** Akei, M.; Amann, J.F.; Chiba, J. and others. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Dec 1988. 6p. Order Number DE89906617/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

With an intension to intensively study hypernuclei via (π^+ K^+) reaction, a series of experiments has started at KEK 12GeV proton synchrotron. As a first step, a simple spectrometer system (PIK spectrometer) for 1 GeV/c region is conducted, and hypernuclear spectra of $_{\Lambda}{}^{56}$Fe and $_{\Lambda}{}^{12}$C are studied with this spectrometer. The PIK spectrometer is installed in the K2 beam line area of the KEK 12GeV PS. The momentum resolution of the spectrometer system is examined with a beam through run at around 720MeV/c, (π, p) reactions in the momentum region of 500MeV/c, and (π, K^+) reaction on ^{12}C target. The beamthrough run shows moMentum resolution of 4MeV/c (FWHM) which corresponds to 0.25% of the incident beam moMentum. In the (π, K^+) reaction on ^{12}C, an energy resolution of 5MeV is obtained for the 1^- ground state of ^{12}C. A missing mass spectrum of pion measured in the (π, p) reaction gives a momentum resolution consistent with the 5MeV resolution of the (π, K^+) spectrum of -Λ^{12}C. A $_{\Lambda}{}^{56}$Fe hypernuclear spectrum is measured by the PIK spectrometer. The energy resolution of the spectrometer for Fe spectrum is estimated at 5.5MeV, taking into consideration energy resolution for $_{\Lambda}{}^{12}$C and energy loss fluctuation in C and Fe targets. Although energy resolution is subject to further improvement, the spectrum shows a gross structure consistent with recent calculations. (N.K.).

43884 (INS–742) **Structure and formation of deeply bound pionic atoms.** Toki, H.; Hirenzaki, S.; Yamazaki, T.; Hayano, R.S. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Mar 1989. 36p. Order Number DE89906508/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

We have calculated spectra of deeply bound pionic atoms using the standard pion-nucleus optical-potential. The widths of the deeply bound states are found to be narrow and are considered as quasi-stable states even for the 1s state in ^{208}Pb. These unexpected results are caused by the repulsive pion-nucleus optical potential which pushes the pionic wave functions outwards so that the pion absorption by the nucleus is weakened. These deeply bound π^- states have hybrid character, somewhere between pionic nuclei and pionic atoms, constituting a pion halo around the nucleus. This result remains relatively unchanged by the use of different optical potentials, as far as they reproduce shallow pionic atoms. We propose to produce these deeply bound pionic atoms, hitherto untouched region, by using the 'pion-transfer' (n,p) reaction, where π^- is transferred to the target nucleus. We have calculated the cross sections for the formation of various deeply bound states via the (n,p) reaction. The calculated cross section increases rapidly with the nuclear charge and indicates that the detection of unexplored deeply bound pionic atoms is feasible. We comment also on the use of complex projectiles for the 'pion-transfer' reactions such as (d, ^{2}He). (author).

43885 (JINR-N–6(32)-88) **JINR rapid communications. Collection of papers.** Joint Inst. for Nuclear Research, Dubna (USSR). 1988. 30p. Order Number DE89012205/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Individual papers are processed separately. (DLC)

43886 (JINR-R–3-88-555) **Set-up for measuring neutron cross sections and radiation multiplicity from neutron-nucleus interaction.** Georgiev, G.P.; Ermakov, V.A.; Grigor'ev, Yu.V. and others. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics. 1988. 11p. (In Russian). Order Number DE89634663/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A multiplicity detector of the "Romashka" type has been used on the 500 m flight part of the IBR-30 pulsed reactor. The detector consists of 16 independent sections with NaJ(Tl) crystals with a total volume of 36 liters. The geometric efficiency of single-ray detection is ~ 80%. The gamma-ray to neutron detection efficiency ratio is $\geq$600 for neutrons with energies below 200 keV. This detector allows one to perform neutron capture and fission cross section measurements and to study gamma-ray multiplicity and resonance selfabsorption effects in the 20 eV-200keV neutron energy range. 3 refs.; 14 figs.

6511 Experimental Techniques

Refer also to citation(s) 43895

43887 (FRCEA-TH–151) **Subthreshold pion production in (p, π^{+-}) reactions at 180 and 201 MeV and (^{3}He, π^{+-}) reactions at 283 MeV.** Million, B. CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale. 1987. 113p. (In French). Order Number DE89908089/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Subthreshold-pion production in (p,$\pi^{\pm}$) reactions at 180 and 201 MeV and (^{3}He,$\pi^{\pm}$) reactions at 94 MeV/N is studied with several targets spanning the periodic table. Two analyzing systems have been used: a magnetic spectrometer and a range telescope. The results are discussed in detail and are compared to those of (^{12}C,π) experiments at 85 MeV/N. The independent-nucleon model is applied to the three reactions: (p,π), (^{3}He,π) and (^{12}C,π). Within this frame, pion production is calculated as an incoherent sum of NN -> πNN collisions where the momentum distribution of the target and projectile nucleons are taken into account. It is shown that this model, which is satisfying for high incident energies, cannot reproduce experimental results for incident energies lower than 300 MeV for the (p,π) reaction and 180 MeV/N for (^{3}He,π) and (^{12}C,π) reactions. In addition, qualitative estimate of the role of pion absorption in the target nucleus has been performed using a classical picture.

43888 (GANIL-P–88-12) **Properties of light nuclei far from stability.** Detraz, C. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1988. 11p. (CONF-880766–: 5. international conference on clustering aspects in nuclear and subnuclear systems, Kyoto (Japan), 25-29 Jul 1988). Order Number DE89781587/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Recent developments in the study of nuclei far from stability are presented with an emphasis on those properties which bring informations on correlations in nuclei.

43889 (PCCF-T–8807) **Experimental study of deuteron production in α-particle collisions with C, Cu and Pb target nucleus at energies ranging from 200 to 800 A. MeV.** Montarou, G. Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire. 1988. 312p. (In French). Order Number DE89792008/JAW. Available from NTIS (US Sales Only), PC A14/MF A01.

Deuteron production in collisions between alpha-particle and carbon, copper or lead target nuclei at 200, 400, 600 and 800 MeV (Mega-electron Volt) per nucleon have been measured by using the large solid angle detector DIOGENE. Nucleus-nucleus collisions at intermediate energies offer the possibility of studying the properties of highly excited nuclear matter at high density and temperature. Among the different observables measured for the determination of the nuclear matter equation of state, light fragment production measurements has raised considerable interest during the last years because of the close relationship between entropy and nuclear cluster formation. A general presentation of the main experimental and theoretical aspects of the relativistic heavy ion collision is presented. The detector DIOGENE used at the SATURNE (Saclay-France) accelerator is described. This detector can measure simultaneously the momenta, masses and emission angles of most of the particles (pions, protons, deuterons ...) emitted in each collision. The method is described that is used to extract from the raw data the momentum, mass and emission angles of each particle measured in the detector. The deuteron production in central relativistic heavy ion collision is reviewed. Then we present the results of deuteron production measurements, using the DIOGENE detector. Deuteron differential cross-sections are compared with theoretical predictions obtained with intra-nuclear cascade model. Deuteron differential cross-sections are presented for the most central reactions. These spectra are investigated in order to extract the size of the interaction region at the end of the collision. Finally the deuteron-to-proton ratio is studied in relationship with the proton number measured in each event; this ratio is used to evaluate the entropy per nucleon in the most central collisions.

6512 Nuclear Properties and Reactions, A=1-5, Experimental

43890 (INIS-SU–96, pp. 54-59) **Deuteron structure in electron scattering in back hemisphere.** Titov, Yu.I. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).

A review of the experimental results of investigation into electron scattering on a deuteron in the back hemisphere, as well as their analysis using relativistic models being developed in KhFTI Ukr SSR Academy of Science is presented. 4 refs.; 6 figs.

6513 Nuclear Properties and Reactions, A=6-19, Experimental

43891 (DOE/ER/40387–3) **Study of structure of nuclei with neutrons and nuclear data measurements for MFE: Progress report, 1 December 1988–31 July 1989.** Lane, R.O.; Grimes, S.M. Ohio Univ., Athens, OH (USA). 1989. 44p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER40387. Order Number DE89016620/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Measurement and analysis of cross sections for neutron-induced reactions of interest to the fusion energy program have been carried out. Studies have included the neutron-induced reactions of ^{9}Be, ^{10}B, ^{12}C, and ^{13}C. Level density studies have been carried out for reactions populating ^{57}Co. Low energy proton elastic scattering has been studied for targets of ^{54}Fe and ^{56}Fe. Data for these studies have been analyzed using either R-matrix studies, combined R-matrix and shell model calculations or Hauser-Feshbach calculations. Details of measurements and theoretical studies are given.

43892 (INIS-SU–96, pp. 121-122) **Low-energy continuum in cross sections of electron inelastic scattering on ^{6}Li nucleus.** Evseev, I.G. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Buki, A.Yu.; Likhachev, V.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).

Spectra of electron inelastic scattering on ^{6}Li nucleus are measured in the LUEh-300 accelerator of the ChPhTI of Ukrainian Academy of Sciences. The contribution of the α-cluster quasielastic knock-out is estimated. The determinant role of this process in formation of low-energy continuum in inclusive electron spectra. 4 refs.; 1 fig.

43893 (INP–1302/PS, pp. 179-186) **Study of the giant Gamow-Teller resonance in nuclear beta decay: the case of ^{32}Ar.** Riisager, K. (0001700DK). Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

The question of the quenching of the Gamow-Teller strength in beta decay is briefly reviewed. A recent experiment on the decay of the proton-rich nucleus ^{32}Ar is described. This experiment gave a quenching factor of 49$\pm$5%. 11 refs., 3 figs. (author).

43894 (JINR-N–6(32)-88, pp. 4-10) **Observation of irregularities in inclusive momentum spectra of protons from nC and π^{-}C interactions.** Kechechyan, A.O. (Erevanskij Fizicheskij Inst., Erevan (USSR)); Shakhbazyan, B.A. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). In *JINR rapid communications. Collection of papers.* Order Number DE89012205/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Inclusive proton spectra from neutron and π^{-} meson interactions with carbon nuclei at 7 GeV/c and 4 GeV/c, respectively, are presented. Significant irregularities in the momentum range from 200 to 400 MeV/c are observed. Possible mechanisms able to explain these irregularities are considered. 13 refs.; 5 figs.; 1 tab.

43895 **Status of the bates parity violation experiment.** Kowalski, S. (Bates Linear Accelerator Center, Lab. for Nuclear Science and Dept. of Physics, Massachusetts Institute of Technology, Cambridge, MA (US)). vp. of Modern developments in nuclear physics. Sushkov, O.P. World Scientific Pub. Co., Teaneck, NJ (1988). (CONF-8706232–: International symposium on modern developments in nuclear physics, Novosibirsk (USSR), 27 Jun - 1 jul 1987).

An experiment designed to measure precisely the parity violating interference in the elastic scattering of longitudinally polarized electrons from ^{12}C is under way at the Bates Accelerator Center. The experiment required the construction of a high intensity polarized injector whose successful operation has been demonstrated. Present efforts are aimed towards the understanding and control of sources of systematic errors and completion of the measurements.

6514 Nuclear Properties and Reactions, A=20-38, Experimental

43896 (INIS-SU–100, pp. 86-91) **Detection of the γ-lines Doppler shift of the ^{24}Na radioactive decay.** Kupryashkin, V.T. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij); Stril'chuk, N.V.; Feoktistov, A.I.; Shapovalova, I.P. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in

nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

A new method of detecting the Doppler shift of γ-quanta energies due to the motion of recoil nuclei after preceeding β- and γ-irradiation is developed. Despite the low value of recoil nuclei velocity after β- or γ-irradiation ($V/c=10^{-4}$-$5x10^{-5}$) the method is reliable in detecting small shift values. The possibilities of the method are shown using ^{24}Na radioactive decay as an example. Radiation energy 2.7 MeV emitted directly after β^--particle in the opposite direction shifts by 61$\pm$6eV. The deceleration time of recoil nuclei in a solid source equalling $5,1x10^{14}$s is estimated, in this case the recoil nuclei pass $3.6x10^{-8}$cm. The above method opens new possibilities of studying the lifetime of highly excited states of nuclei in (n,γ) reactions on thermal neutrons ($T_{1/2}=10^{-13}$-10^{-15}s) and the processes of ion deceleration having low velocities in different materials. 4 refs.

43897 (IPNO-DRE–89-02) **β-delayed proton decay of ^{28}S.** Pougheon, F.; Borrel, V.; Jacmart, J.C.; Anne, R.; Detraz, C.; Guillemaud-Mueller, D.; Mueller, A.C.; Bazin, D.; Del Moral, R.; Dufour, J.P. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1989. 27p. Order Number DE89908093/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

β-delayed proton radioactivity has been observed for the ^{28}S isotope (T_x = -2), produced by projectile fragmentation of 85 MeV/u ^{36}Ar. The measured half-life of ^{28}S is 125 $\pm$ 10 ms. Energy spectra of β-delayed protons have been measured. The lowest T = 2 state in the daughter nucleus ^{28}P has been located at an excitation energy of 5900 $\pm$ 21 keV. A comparison of the experimental data to the quadratic form of the isobaric multiplet mass equation shows that the energies of the five T = 2 states of the A = 28 quintet are well represented by that relation. Shell-model predictions for the half-life, location and decay properties of the lowest T = 2 state of ^{28}P are in good agreement with experimental data.

6515 Nuclear Properties and Reactions, A=39-58, Experimental

Refer also to citation(s) 43891

43898 (BNL–42974) **Hypernuclear physics with the (π^+, K$^+$) reaction.** Millener, D.J.; Chrien, R.E. Brookhaven National Lab., Upton, NY (USA). [1989]. 22p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8906194–1: International meeting on physics at KAON, 7-9 Jun 1989). Order Number DE89016410/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The study of hypernuclei affords unique insights into the nature of hadronic forces beyond those obtainable from ordinary nuclear physics research. A hypernucleus consists of one or more hyperons bound to a nuclear core. In the SU(3) classification, Λ,Σ, and Ξ hyperons occupy the same octet representation of spin-parity $\frac{1}{2}^+$ baryons as the neutron and proton, the familiar constituents of ordinary nuclei. The Λ and Σ possess strangeness S = -1 and isotopic spin I = 0, 1, respectively, while the Ξ has S = -2, I = $\frac{1}{2}$. In the underlying quark picture, the Λ and Σ have the flavor structure $s(ud)_{I=0,1}$, compared to the combination uud for the proton. The strange quark, s, carries the strangeness quantum number S = -1, which makes it distinguishable from the S = 0 u and d quarks. The lowest-lying hyperon is the Λ, with a mass of 1,115.6 MeV/c^2, some 177 MeV/c^2 heavier than the proton. The study of the behavior of a hyperon embedded in the nuclear medium, through the theoretical analysis of level spectra, sheds light on the nature of the hyperon-nucleon (YN) effective interaction, i.e. on the role of the strange quark in strong interactions. This paper investigates the (π^+, K$^+$) reactions that produce hypernuclei. 32 refs., 5 figs., 2 tabs.

43899 (INIS-SU–100, pp. 133-135) **Use of the precision gamma-spectrometry and the method of normales at experimental evaluation of the reactions cross sections under the action of fast neutrons.** Gopych, P.M. (Khar'kovskij Gosudarstvennyj Univ., Kharkov (Ukrainian SSR)); Demchenko, M.N.; Zalyubovskij, I.I. and others. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The procedure of experimental estimate of cross sections using standard cross sections (normales) is described. The main attention is paid to the precision of determination of efficiencies of registering analytical line γ-quanta in measurements whose unfavourable features are: source extension; measurement geometry with no respect to the assumption of geometry "point nature"; effects of γ-quanta self-absorption in a sample. It is shown that the unfavourable effect of the above factors on the precision of experiments can be excluded and the resulting precision of cross section determination equalling $\sim$ 3-5% obtained due to the measurement procedure suggested, in this case the absence of systematic errors is guaranteed. 7 refs.

43900 (INP–1302/PS, pp. 286-299) **Effects of inelastic interaction of fast α particles with nuclei.** Decowski, P. (Warsaw Univ. (Poland). Wydzial Fizyki). Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

Results of recent experiments performed in IKP - KFA, Juelich in which coincident α- and ^{3}He-proton spectra were measured in reactions induced by fast α particles (43 MeV/N) interacting with light (^{58}Ni) and heavy (^{238}U) targets. 6 refs., 10 figs. (author).

43901 (ISN–88-62) **Alignment of protons and $h_{11}2$/neutrons and configurations of two quasi-particles in the Ba124 nucleus.** Martin, J.P. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. 1988. 140p. (In French). Order Number DE89908209/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

High spin states of ^{124}Ba, ^{125}Ba and ^{125}Cs have been populated in the reactions ^{98}Mo+^{34}S and ^{96}Zr+^{34}S at 160 MeV and ^{110}Cd+^{18}O at 80 MeV. They have been studied using spectroscopy techniques gamma-gamma angular distribution and linear polarization measurements with the french multidetector array Chateau de cristal. Seven collective bands have been established in ^{124}Ba. The negative parity bands in ^{125}Ba and ^{125}Cs, produced by the coupling of a $h_{11}2$/neutron-hole and $h_{11}2$/proton to doubly even core respectively, have been extended up to 47/2$^-$. According to aligned angular momenta and band crossing frequencies it is shown that the two positive parity bands in ^{124}Ba are generated by alignments of $h_{11}2$/neutrons and $h_{11}2$/protons, respectively. We also propose that the three negative parity bands are generated by coupling of two quasiparticles: $h_{11}2$/, $g_7 2$/quasi-neutrons and $h_{11}2$/, $g_7 2$/or $g_9 2$/ quasi-protons. Experimental data are compared to theoretical calculations made in a Woods-Saxon model. These calculations show that a $h_{11}2$/proton pair alignment is associated with a prolate collective behaviour while a $h_{11}2$/neutron pair alignment increases the triaxial character of the nucleus. Systematics of crossing frequencies and beta and gamma deformations associated with $h_{11}2$/proton and $h_{11}2$/neutron bands are given for doubly even baryum nuclei.

43902 (LBL–27387) **Decay studies of nuclei near the proton drip line: ^{35}Ca, ^{31}Ar, ^{69}Br, ^{65}As.** Reiff, J.E. Lawrence Berkeley Lab., CA (USA). Jun 1989. 100p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89015342/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Studies of new beta-delayed two-proton emitters and a search for ground state proton radioactivity in medium mass nuclei were performed using various experimental techniques in conjunction with several detection systems. A helium-jet transport system and three-element silicon telescopes were used to discover the existence and detect the decay of the first T_Z = $-5/2$ nuclide, ^{35}Ca. Two-proton emission from the T = 5/2 isobaric analog state in ^{35}K at an excitation energy of 9.053 $\pm$ 0.045 MeV, fed by the superallowed beta decay of ^{35}Ca, resulted in transitions to both the ground state and first excited state of ^{33}Cl. The corresponding two-proton sum energies were 4.089 $\pm$ 0.030 MeV and 3.287 $\pm$ 0.030 MeV.

Measurements of the individual proton energies indicated the prevalence of a sequential decay mechanism. Using the isobaric multiplet mass equation, the mass excess of ^{35}Ca was calculated to be 4.453 ± 0.060 MeV. In order to study whose half-lives were too short for the helium-jet system, an in-beam recoil catcher wheel was constructed. The wheel speed can be varied to study nuclides whose half-lives range from 100 μs to ~250 ms. The first new decay observed with the wheel system and traditional ΔE-E telescopes was the beta-delayed two-proton emission from ^{31}Ar. The two-proton sum energy of ~7.5 MeV corresponds to a transition from the isobaric analog state in ^{31}Cl to the ground state of ^{29}P. The search for proton radioactivity required the development of low energy, particle identification detector telescopes. These telescopes, comprised of a gas ΔE and silicon E, were used in conjunction with the in-beam recoil catcher wheel to search for ground state proton emission from ^{69}Br and ^{65}As. 90 refs., 24 figs., 8 tabs.

6516 Nuclear Properties and Reactions, A=59-89, Experimental

Refer also to citation(s) 41794, 43898, 43902, 43986

43903 (INIS-SU–96, pp. 102-105) **Diffusivity parameters of ^{74,76,78,80,82}Se isotope charge density distribution.** Khomich, A.A. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Shevchenko, N.G.; Buki, A.Yu.; Polishchuk, V.N.; Mazan'ko, B.V.; Kuprikov, V.I.; Soznik, A.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).

Differential cross sections of electron elastic scattering at 225 MeV energy on ^{74,76,78,80,82}Se isotopes are measured. Parameters characterizing the charge density distribution (CDD) of selenium isotopes are determined. The rule of regular behaviour of the maximum CDD gradient as the neutron subshell is filled is discovered. The results are compared with those calculated by the Hartree-Fock method. 13 refs.; 3 tabs.

43904 (INIS-SU–96, pp. 113-116) **Electroexcitation of giant multipole resonances in ^{65}Cu nucleus.** Savitskij, G.A. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Fartushnyj, V.A.; Evseev, I.G.; Likhachev, V.P.; Nemashkalo, A.A.; Pashchuk, S.A.; Ranyk, Yu.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2(3ʊ); no. 3(39).

Using electron inelastic scattering different multipole electric transitions in ^{65}Cu nucleus in the 1-37 MeV excitation energy range are studied. The reduced transition probabilities determined on the basis of experimental data provide excitation energy concentration in terms of separate branches of giant multipole resonances. 12 refs.; 2 tabs.

43905 (INP–1302/PS, pp. 384-393) **Angular momentum release by the evaporation of particles from compound nuclei around mass 60.** Skulski, W. (Warsaw Univ. (Poland)). Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

A study of the angular momentum release by particle emission from medium heavy compound nuclei around the mass 60 is presented. The cross section weighted average over the mass number removed from a compound nucleus (ΔA)-bar and the dependence of Δ-barA-bar on excitation energy are investigated. 9 refs., 5 figs. (M.F.W.).

6517 Nuclear Properties and Reactions, A=90-149, Experimental

Refer also to citation(s) 43925, 43928, 43985, 43986

43906 (BNL–42948) **Sudden shape change from shperical to maximally deformed for A≃100 nuclei.** Wohn, F.K.; Mach, H.; Moszynski, M.; Gill, R.L.; Casten, R.F. Brookhaven National Lab., Upton, NY (USA). 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016;W-7405-ENG-82. (CONF-890583–2: Symposium on the occasion of the 40th anniversary of the nuclear shell model, Argonne, IL (USA), 25-27 May 1989). Order Number DE89016413/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Among the unusual features of neutron-rich A≃100 nuclei is a sudden change of nuclear shape. The analysis of B(E2) and B(M1) values from recent level lifetime measurements indicates that Sr (and perhaps also Zr) nuclei obtain their largest deformations for the nuclei at the onset of deformation, which suggest a "phase change" from a spherical to a maximally deformed shape. 15 refs., 6 figs.

43907 (INIS-SU–100, pp. 29-34) **How much does the value of the coefficient of the mixture δ^2(E2/M1) for the 35,48 keV transition in the ^{125}Te nucleus depend on the way of its determination?.** Davidonis, R.J.; Zhirgulevichius, R.K.; Kalinauskas, R.A. and others. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The experimental ICC ratios for 35,48 keV transition in the ^{125}Te nucleus determined with the 1-5% accuracy using the prism beta-spectrometer UMB-1 and appropriate theoretical ratios calculated according to the known program with various wave functions, using the Hager-Seltzer and Roessel and others tables are compared. The reasons for δ^2(E2/M1) scattering obtained using different theoretical ICC and different experimental ICC ratios are discussed. 13 refs.; 3 figs.; 1 tab.

43908 (INIS-SU–100, pp. 92-97) **Experimental search of the chemical change of the ^{114m}In γ-spectrum lines intensities.** Davidonis, R.J.; Dragunas, A.K.; Makariunas, K.V.; Remeikis, V.V.; Ruzhele, B.P. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The experiments aimed at measuring small changes of intensity ratios of ^{114m}In gamma-lines when radionuclides are in various chemical compounds, are reported. The effect studied is conditioned by the effect of the chemical change of radionuclide electron structure on the probability of ^{114m}In branch decay occurring by way of electron capture which in this case can be neasured by no other known method. The technique of control and exception of systematic errors is developed. The maximum measurement accuracy in the experiments of this type is estimated. The measurements and results processing are performed using a computerized γ-spectrometer. The sensitivity of determination of the relative change of $\Delta I_\gamma/I_\gamma$ intensity about $1x10^{-4}$, is obtained. The effects at the level of several units on 10^{-4} are observed. 6 refs.; 2 figs.; 1 tab.

43909 (INIS-SU–100, pp. 156-161) **Refining the values of the ^{109}Cd and ^{170}Tm radiation characteristics on the basis of the radionuclides decay data analysis.** Kuz'menko, N.K.; Nedovesov, V.G.; Chechev, V.P. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, 26-27 May 1988).

In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

Taking into account the results of international comparison of specific activity of ^{109}Cd radionuclide solution and the new experimental data obtained when measuring nuclear physical characteristics (NPC) of ^{109}Cd and ^{170}Tm radionuclides, the totality of data on the decay of these radionuclides is analyzed and the new estimated NPC values for ^{109}Cd and ^{170}Tm are obtained. The absolute γ-radiation intensities and those of XK-radiation components are specified. 8 refs.; 1 fig.; 1 tab.

43910 (INP–1302/PS, pp. 164-178) **Beta decay and nuclear structure near $_{50}{}^{100}Sn_{50}$.** Zylicz, J. (Warsaw Univ. (Poland). Wydzial Fizyki). Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

A brief report on beta decays of those neighbouring even-A nuclei which have already been reached in the experiment is given. The emphasis is put on the identification and strength determination of the 0^+ -> 1^+ Gamow-Teller (GT) beta transitions. The data presented in the work come mostly from the experiments carried out in Darmstadt by the GSI on-line-mass-separator group in collaboration with several universities. However, some results obtained in other laboratories have been included for completeness. 23 refs., 5 figs., 1 tab. (author).

43911 (INP–1302/PS, pp. 350-355) **Giant GT$^+$ excitation of ^{148}Dy populated in β-decay.** Kleinheinz, P. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik); Zuber, K.; Protop, C.; Zuber, J.; Liang, C.F.; Paris, P.; Blomqvist, J. Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

The decay scheme of ^{148}Dy produced through (^{3}He,xn) reactions using a 240 MeV ^{3}He beam and natural Gd target are given. Fourteen new ^{148}Tb energy levels with firm I$^\pi$ assignments or with narrow limits are identified. Proposed shell model configuration assignments are given and it was found that 97% of the β-decay intensity feeds the 620 keV 1^+ state which is the GT$^+$ giant resonance on the ^{148}Dy ground state. 15 refs., 2 figs. (M.F.W.).

43912 (INP–1302/PS, pp. 362-364) **Quasiparticle excitations in light even-even barium nuclei.** Schiffer, K. (Koeln Univ. (Germany, F.R.). Inst. fuer Kernphysik); Dewald, A.; Gelberg, A.; Reinhardt, R.; Schmittgen, K.P.; Xiangfu, S.; Zell, K.O.; Brentano, P. von. Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

The nucleus ^{126}Ba has been populated by means of the ^{116}Sn(^{13}C,3n)-reaction. Standard in-beam gamma ray experiments such as γ-excitation functions, γ-angular distributions and γ-γ-coincidence experiments were carried out.The observed level scheme of ^{126}Ba is shown. 7 refs., 2 figs. (M.F.W.).

43913 (INP–1302/PS, pp. 369-381) **Particle-phonon multiplets in $_{63}{}^{145}Eu_{82}$.** Rubio, B. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik); Kleinheinz, P.; Ercan, A.; Julin, R.; Mann, L.G.; Stoeffl, W.; Henry, E.A.; Dave, V.; Blomqvist, J. Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

In order to populate ^{145}Eu levels above the yrast line, including members on low-lying particle x phonon multiplets, low-spin (p,3n), (t,2n) and (d,n) compound reactions have been used. The ^{145}Eu level scheme is shown. In experiment eleven negative parity states between 1.3 and 1.9 MeV which are assign as members of the two low lying octupole multiplets are found. A synopsis of the calculated and observed octupole mulptiplet members based on the three lowest single proton states $d_5 2/^{-1}$ (0 keV), $g_7 2/^{-1}$ (330 keV), and $h_{11} 2/$(716 keV) is given and these three multiplets are discussed. 8 refs., 5 figs. (author).

43914 (INP–1302/PS, pp. 382-383) **(n,n'γ) and shell model study of the N=82 nuclei ^{138}Ba and ^{140}Ce.** Dioszegi, I. (Magyar Tudomanyos Akademia, Budapest (Hungary). Izotopintezete); Veres, A.; Enghardt, W.; Prade, H. Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

Published in summary form only. 3 refs.

43915 Decays of millisecond isomers in odd-odd N=81 nuclei ^{146}Tb, ^{148}Ho and ^{150}Tm. Broda, R. (Purdue Univ., Lafayette, IN (USA)); Daly, P.J.; McNeill, J.H.; Grabowski, Z.W.; Janssens, R.V.F.; Lawson, R.D.; Radford, D.C. *Zeitschrift fuer Physik A: Atomic Nuclei (F.R. Germany),* 334(1): 11-17 (Sep 1989). DOE Contract W-31-109-ENG-38.

Following reactions induced by 245 MeV ^{60}Ni ions, isomers have been identified in the odd-odd N=81 isotones ^{146}Tb, ^{148}Ho and ^{150}Tm with half-lives of 1.18(2), 2.35(4) and 5.2(3) ms, respectively. Their decays have been characterized by γ-ray spectroscopy. The isomers are interpreted as ($\pi h_{11} 2/\nu h^{-1}{}_{11} 2/$)$10^+$ states decaying to members of $\pi h_{11} 2/\nu d^{-1}{}_3 2/$and $\pi h_{11} 2/\nu s^{-1}{}_{1/2}$ multiplets. The observed level spectra and M1 branching ratios are found to be in good agreement with shell model predictions based on empirical and Schiffer-True $\pi\nu^{-1}$ residual interactions. (orig.).

6518 Nuclear Properties and Reactions, A=150-189, Experimental

Refer also to citation(s) 43767, 43909, 43915

43916 (GANIL-P–89-02) **β-delayed neutron emission of the isotopes ^{20}C, ^{40}P, ^{41}P, ^{42}P and ^{43}S, ^{44}S.** Mueller, A.C.; Guillemaud-Mueller, D.; Anne, R.; Bazin, D.; Detraz, C.; Guerreau, D.; Saint-Laurent, M.G.; Borrel, V.; Jacmart, J.C.; Pougheon, F. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1989. 10p. Order Number DE89908094/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Very neutron-rich isotopes have been produced by the fragmentation of 55 MeV/u ^{48}Ca projectiles from GANIL onto a ^{181}Ta target. The nuclei were separated by means of the doubly achromatic spectrometer LISE and implanted into a semiconductor telescope for identification in Z and A. Their β-delayed neutron radioactivity is observed by means of a 4 π β-n coincidence detector. The results include first measurements of the halft-life $T_{1/2}$ and the neutron emission probability P_n for the isotopes ^{20}C, ^{40}P, ^{41}P, ^{42}P and ^{43}S, ^{44}S. They are compared to current theoretical predictions.

43917 (INIS-SU–100, pp. 9-14) **Precision of determination of the energies and intensities of transitions from the data on internal conversion electrons.** Sushkov, P.A. (AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki); Mak Magon, T.D. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The data on ICE for the ^{103}Rh(n,γe) reaction measured using the magnetic β-spectrometer (BILL), Grenoble, France, are analyzed. About 400 peaks in the 14-800 keV energy range are found in the ICE spectrum. The energies and intensities of ICE peaks are determined, energies and intensities of ^{104}Rh transitions are specified, multipolarities of about 200 transitions are determined. It is shown

that it is possible to determine transition energies with the precision up to 3ppm and transition intensities-with the precision ~ 1% using the ICE spectra. The data on 31 and 77 keV transitions from the ^{103}Rh M3 reaction and E3 multipolarities, respectively, are given. Gamma intensity of 31 keV transition equalling 27,5(14)x10^{-6} kV/100n is obtained. The data for ^{104}Rh Auger electrons are given. 5 refs.; 1 fig.; 3 tabs.

43918 (INIS-SU–100, pp. 15-19) **Precision measurements of the energy of some transitions of the ^{184,184m}Re decay.** Bulgakov, V.V. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij); Lashko, A.P.; Sidorenko, L.P. and others. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The magnetic high-resolution beta-spectrometer of the $\pi\sqrt{2}$ type has been used to measure the energy differences of close conversion lines directly in eV. In this case one of the lines referred to ^{183}Re decay where the transition energies are known with high precision, the other - to ^{184,184m}Re decay. The values of transition energies that can be used for spectrometer calibration are obtained. The technique of measurements is discussed. 4 refs.; 1 tab.

43919 (INIS-SU–100, pp. 3-8) **Precision limits for the data, obtained by β-spectrometers $\pi\sqrt{2}$(rho$_0$=50 cm) within the 5-2000 keV electron spectra range.** Kartashov, V.M. (AN Kazakhskoj SSR, Alma-Ata (USSR). Inst. Yadernoj Fiziki); Oborovskij, A.I.; Troitskaya, A.G. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

It is shown that the pulse resolution attained in the devices of this type is ~0.05% in the range E$_e$=5-30 keV and 0.03-0.02% for E$_e$>30keV. In this case we can clearly register lines 10^6 times differing in intensity. The requiremenrs to the quality and thickness of layer of solid radioactive source placed on substrate, to the type of its material, its effect on shape and width of lines in a wide energy range, the order in atom location, medium of electron passing, possibility of spectra calibration (in energy) in the 5-10 keV energy range are discussed. It is shown that the use of relative H$_{rho}$ measurements for two electron lines corresponding to one and the same γ-transition permits to attain precision in energy distribution within the whole range discussed 1x10^{-4}-5x10^{-5}. The relative accuracy of determining the intensity of the strongest lines can reach 0.5%. 8 refs.; 3 tabs.

43920 (INIS-SU–100, pp. 130-132) **On experimental determination of the kind of the decay law at a short period of detection.** Gopych, P.M. (Khar'kovskij Gosudarstvennyj Univ., Kharkov (Ukrainian SSR)); Demchenko, M.N.; Zalyubovskij, I.I. and others. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

A number of theories predict the deviations from the exponential decay for short detection times t/T$_{1/2}$->O: either short-period oscillations or decay deceleration (Zenon quantum effect) are expected. The experimental data of this paper and the literary data are used to analyze the degree of experimental research of the type of the decay law for the nuclei of one "age" for detection period 10^{-10}< or approx. t/T$_{1/2}$ < or approx.10^{-1}. It is shown that the available experimental data do not permit to speak about the detecting (in this time range) of deviations from exponentiality the etails of experiments are discussed. 5 refs.; 1 fig.

43921 (INP–1302/PS, pp. 73-80) **Longlived high-spin states in deformed nuclei-particle alignment and nuclear shape.** Emling, H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

On the ground of the experimental data a spin dependence of the nuclear shape has been shown. In both regions of transitional rare earth nuclei (of prolate ground-state deformation $\beta\geq$0.2, the N=87, 88 isotopes Er, Dy and the N=104-107 Os isotopes) the two-quasiparticle states ν(i$_{13}$2/) seem to induce triaxial shape. At still higher spins the oblate configuration seems to be energetically favoured against the prelate configuration as was found in the N=87, 88 region. 10 refs., 4 figs. (author).

43922 (INP–1302/PS, pp. 81-99) **Gamma-decay from Dy nuclei at high temperature.** Guttormsen, A. (Oslo Univ. (Norway). Fysisk Inst.); Atac, A.; Ingebretsen, F.; Ramsoey, T.; Rekstad, T.; Loevhoeiden, G.; Roedland, T.; Thorsteinsen, T.F. Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

States up to high excitation energies have been populated in the ^{161,163}Dy(d,t) and ^{162,163}Dy(^{3}He,αxn) reactions. The γ-decay following the pick-up reactions is investigated using Ge and NaI detectors. Both reactions reveal characteristic γ-ray bumps and the global properties of these bumps are emphasized. The origin of 1 MeV and 2 MeV γ-ray bumps is discussed within a modified Fermi gas model. 8 refs., 11 figs., 1 tab. (author).

43923 (INP–1302/PS, pp. 321-323) **G-factors of collective states of ^{166}Er.** Alzner, A. (ISKP Bonn (Germany, F.R.)); Bodenstedt, E.; Gemuenden, B.; Hoff, J. van den. Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

The variation of g-factors as a function of angular momentum has been studied for spins up 8$^+$ for the nucleus ^{166}Er. The g-factors of the 4$^+$-265 keV state, the 8$^+$-911 keV state and the 6$^+$-1216 keV state were obtained by use of the integral perturbed γ-angular correlation technique (IPAC). 5 refs., 5 figs. (L.I.).

43924 (INP–1302/PS, pp. 413-416) **Study of the nonequilibrium process for individual channels of the ^{159}Tb(α, charged particle xn) reactions.** Bochev, B. (Bylgarska Akademiya na Naukite, Sofia (Bulgaria). Inst. za Yadrena Izsledvaniya i Yadrena Energetika); Kutsarova, T.; Lieder, R.M.; Morek, T.; Didelez, J.P. Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

The present report includes selected results of a systematic study of the reaction ^{159}Tb(α,ch.p.xnγ) for α beams of 45,75 and 110 MeV. The data are compared with the calculations of the recently developed quantum mechanical model which considers both the direct and the compound aspects of the reaction. 1 fig., 1 tab. (author).

43925 (INP–1302/PS, pp. 424-432) **Masses of the nuclei far from the beta stability line.** Kormicki, J. (Institute of Nuclear Physics, Cracow (Poland)); Potempa, A.; Sieniawski, J. Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number

DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

Beta decay energies for nuclei located at the end of long chains of alpha decay have been measured in order to determine masses of wide range of nuclei far from the beta stability line. 15 refs., 4 figs., 3 tabs. (author).

43926 (JINR-R–7-88-388) **Production of light nuclei in boron-11 and neon-20 heavy ion reactions with 18-20 MeV/nucleon energies.** Belozerov, A.V.; Borcea, K.; Gul'bekyan, G.G. and others. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions. 1988. 14p. (In Russian). Order Number DE89634676/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The energy and angular distributions of light nuclei with $2 \leq Z \leq 8$ and $3 < A < 20$, formed in the ^{181}Ta (^{232}Th) + ^{20}Ne (18 MeV/nucleon) and ^{181}Ta(^{232}Th) + ^{11}B (20 MeV/nucleon) reactions are presentd. It is shown that isotopes with atomic and mass numbers close to the projectile Z and A values are formed basically in transfer reactions. To the formation of lighter products several processes contribute: prompt and sequential breakup of the projectile after massive transfer, and also cluster evaporation either from an excited composite system or from a residual nucleus. It is found that the yield of Li and Be isotopes rises by about two orders of magnitude when increasing the projectile energy from 8 and 18 MeV/nucleon. Further perspectives for the synthesis of ^{10}He and ^{13}Li and for the production of secondary beams of ^{6,8}He and ^{8,9}Li nuclei are analyzed. 16 refs.; 13 figs.; 2 tabs.

6519 Nuclear Properties and Reactions, A=190-219, Experimental

43927 (INIS-SU–100, pp. 35-40) **Precise ICC measurement of the high multipolarity transitions.** Zheltonozhskij, V.A. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij); Ukhin, M.A. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The methods of γ-spectroscopy are used to measure internal conversion coefficients (ICC) on the K-shell and total ICC for M4,E4,E5-multipolarity transitions. The research is carried out using the ^{202,204}Pb, ^{197}Pt, ^{114}In isomers. The data obtained prove that the observed systematic excess of theoretical ICC for M4-multipolarity transitions as compared with the experimental values is most probably connected with the contribution of "intranuclear" conversion. 13 refs.; 2 figs.

43928 (INP–1302/PS, pp. 236-277) **Laser spectroscopic studies of the isotopic variation of nuclear charge radii.** Rebel, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik 3). Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

The importance of laser spectroscopic measurements of isotope shifts and hyperfinestructure splittings in long isotopic series of stable and radioactive nuclides for nuclear structure studies is demonstrated by recent experiments with Pb, Sn and Sr-isotopes. First measurements of Am by optogalvanic laser spectroscopy are discussed stressing methodical aspects. 55 refs., 31 figs. (author).

43929 (INP–1302/PS, pp. 346-349) **E0 decay of 0$^+$ states in ^{208}Pb.** Julin, R. (Jyvaeskylae Univ. (Finland). Dept. of Physics); Kantele, J.; Luontama, M.; Passoja, A.; Trzaska, W.; Blomqvist, J. Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

A conversion-electron spectrum from the ^{207}Pb(d,p)^{208}Pb reaction at E_d=10 MeV is obtained. It exhibits two strong high-energy E0 lines corresponding to transition energies of 4863±5 keV and 5233±5 keV in Pb. These energies agree with those for the neutron -and proton - pairing vibrational 0$^+$ states. In addition to known E1 transitions from strongly populated 1$^-$ states, many new high-energy electron lines are observed in this spectrum. These lines can be identified with new M2 and E3 transitions from known lines to the ground state in ^{208}Pb. 4 refs., 2 figs. (M.F.W.).

43930 (INP–1302/PS, pp. 365-368) **Evidence for 0$^+$ intruder states in the even-even Pb nuclei.** Van Duppen, P. (Louvain Univ. (Belgium). Inst. for Nuclear- and Radiationphysics); Coenen, E.; Deneffe, K.; Huyse, M.; Wood, J.L. Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

We report on the identification of 0$^+$ intruder states in the $^{190-200}$Pb nuclei. The β^+/EC decay of $^{192-200}$Bi was used to search for 0$^+$ states in $^{192-200}$Pb (charactrerised by their E0 groundstate transition). A 0$^+$ state in ^{190}Pb was identified in the α decay of ^{194}Po. 14 refs., 2 figs., 1 tab. (author).

43931 (INS–738) **Alpha decays of ^{221}Pa and ^{218,219}Ac.** Miyatake, H.; Nomura, T.; Kubono, S. and others. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Mar 1989. 22p. Order Number DE89906504/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The α-decays of neutron deficient actinium (^{218,219}Ac) and protoactinium (^{221}Pa) nuclides produced in the ^{16}O-bombardment of ^{205}Tl and ^{209}Bi have been studied using a gas-filled recoil isotope separator (GARIS). Their α-decays were detected with a large Si counter placed at a focal plane of GARIS. The α-decay energy of ^{221}Pa has been measured for the first time to be E_α = 9.08 ± 0.03 MeV. The half-lives of ^{221}Pa, ^{218}Ac and ^{219}Ac were determined more precisely than those reported previously; they are 5.9 ± 1.7, 1.06 ± 0.09 and 11.8 ± 1.5 μs, respectively. The present value for ^{219}Ac is significantly different from the previous measurement. The reduced α-widths of N = 130 isotones are compared with the shell model calculations. (author).

6520 Nuclear Properties and Reactions, A=220 and Above, Experimental

Refer also to citation(s) 43900, 43931, 43992

43932 (INIS-mf–11495, pp. 67-69) **L and M shell x-ray branching ratios for ^{237}Np.** Cohen, D.D. (Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). Nov 1987. (CONF-8711240–: Australian joint artificial intelligence conference, Sydney (Australia), 2-4 Nov 1987). In *Fifth Australian conference on nuclear techniques of analysis : proceedings.* Order Number DE89632463/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

Radioactive ^{241}Am sources have been used extensively for many years for the absolute efficiency calibration of Si(Li) detectors. However in most of these cases the Np X-rays produced by the alpha decay of ^{241}Am have been considered as coming from only four distinct groups, the M, L α, L β and L γ groups. Modern Si(Li) detectors, with resolutions upwards of 140 eV, are capable of resolving more than 20 X-ray lines from these groups between 2 and 25 keV. This fact coupled with the well established γ-ray transitions at 26, 33, 43 and 59 keV make ^{241}Am sources ideal for the absolute efficiency calibration of Si(Li) detectors in the 1 to 60 keV X-ray region. Here we identify some 39 Np M and 39 Np L transitions from the decay of ^{241}Am and present the relative intensities of the 28 resolvable X-ray peaks using a Si(Li) detector. Their ^{241}Am X-ray branching ratios together with the efficiency models presented in earlier papers and the γ-ray relative intensities enable the absolute

calibration of a Si(Li) detector using just one source over the photon energy range 1 to 60 keV.

43933 (INIS-SU–98, pp. 45) **Fission duration for nuclei produced in the ^{235}U+d reaction.** Melikov, Yu.V.; Platonov, S.Yu.; Tulinov, A.F.; Fotina, O.V.; Yuminov, O.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

Short Communication

43934 (INIS-SU–98, pp. 46) **Determination of ^{232}Pa fission barrier parameters by the shadow method.** Eremenko, D.O.; Kordyukevich, V.O.; Syutkina, L.N.; Platonov, S.Yu.; Tulinov, A.F.; Fotina, O.V.; Yuminov, O.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

Short Communication

43935 (INP–1302/PS, pp. 100-141) **Recent spectroscopic results in the Pb-region.** Maier, K.H. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.)). Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

Using triton projectiles for γ-spectroscopy enabled me to study a few simple configurations close to ^{208}Pb. Particularly some informations on proton-hole states about which very little is known, could be gathered. The g-factor of the $h_{11}2$/hole agrees with that what is expected from its spin-orbit partner, while its effective charge is larger. With heavy ion beams N=126 and N=128 isotones have been studied. Magic N=126 isotones can in part be astonishingly well explained by the most simple pairing model, when the levels of highest spin are taken as the unpaired reference states. The N=128 nuclei show a very steady trend versus proton number, their level schemes and electromagnetic properties agree with shell model except for an increased effective quadrupole charge. 32 refs., 17 figs., 3 tabs. (author).

43936 Multifragment emission observed for the reaction ^{36}Ar + ^{238}U at *E/A*=35 MeV. Kim, Y. D. (National Superconducting Cyclotron Laboratory and Department of Physics Astronomy, Michigan State University, East Lansing, Michigan 48824 (US)); Tsang, M. B.; Gelbke, C. K.; Lynch, W. G.; Carlin, N.; Chen, Z.; Fox, R.; Gong, W. G.; Murakami, T *Physical Review Letters (USA),* 63(5): 494-497 (31 Jul 1989).

The dependence of multifragment-emission processes upon linear momentum transfer to the target residue is determined for ^{36}Ar-induced reactions on ^{238}U at *E/A*=35 MeV. Significantly more intermediate-mass fragments are emitted in central collisions. Multiplicity distributions for intermediate-mass fragments emitted behind the grazing angle resemble Poisson distributions and are consistent with a stochastic production process. Exit channels with up to five intermediate-mass fragments and two fission fragments were observed.

6530 Nuclear Theory

Refer also to citation(s) 42037, 43728, 43818, 43910, 44190

43937 (AD-A–205318/9/XAB) **IDA (Institute for Defense Analyses) gamma-ray laser annual summary report (1986). Investigation of the feasibility of developing a laser using nuclear transitions. Final report, 1 October 1985-30 September 1986.** Balko, B.; Cohen, L.; Sparrow, D.A. Institute for Defense Analyses, Alexandria, VA (USA). Dec 1988. 256p. (IDA-P–2004). Available from NTIS, PC A12/MF A01.

This report summarizes the IDA research effort in FY 1986 investigating the feasibility of developing a gamma-ray laser.

43938 (AD-A–205319/7/XAB) **IDA (Institute for Defense Analyses) gamma-ray laser annual summary report (1987). Investigation of the feasibility of developing a laser using nuclear transitions. Final report, October 1986-September 1987.** Balko, B.; Cohen, L.; Sparrow, D.A.; Nicoll, J.F. Institute for Defense Analyses, Alexandria, VA (USA). Dec 1988. 87p. (IDA-P–2083). Available from NTIS, PC A05/MF A01.

This report summarizes the IDA research effort in FY 1987 in investigating the feasibility of developing a gamma-ray laser.

43939 (DOE/ER/40335–4) **Theoretical nuclear physics: Progress report, October 1, 1988–August 1, 1989.** Kunz, P.D.; Rost, E.; Shepard, J.R. Colorado Univ., Boulder, CO (USA). Dept. of Physics. 1989. 41p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER40335. Order Number DE89015918/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report contains papers on the following topics: Dirac RPA analysis of the inelastic scattering of 500 MeV protons from ^{40}Ca; giant resonances at complex excitation energies; analysis of the $0^+ \rightarrow 0^-$ inelastic scattering reaction at intermediate energies; nonlocal correction factor at intermediate energies; deuteron knockout in the (e,e'd) reaction; Coulomb-nuclear interference in pion inelastic scattering; instability of nuclear matter in a relativistic mean field model; spin-flip cross sections for $^{13}C(\vec{p},\vec{n})^{13}N(g.s.)$ at 500 MeV; vacuum fluctuation effects in open-shell nuclei within the relativistic $\sigma - \omega$ model; and $^3P_0$ and $^3S_1$ contributions to $\bar{p}p \rightarrow \bar{\Lambda}\Lambda$.

43940 (ENEA-RT-TIB–88-17) **Contributions to perspectives on theoretical nuclear physics-2.** Maino, G.; Ventura, A.; Guidotti, R.; Saporetti, F.; Zuffi, L. ENEA, Rome (Italy). 1988. V Order Number DE89012193/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Individual contributions are separately indexed.

43941 (ENEA-RT-TIB–88-17) **Contributions to "Perspectives on theoretical nuclear physics-2" (1987).** Maino, G.; Ventura, A.; Guidotti, R.; Saporetti, F.; Zuffi, L. Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Dipt. Tecnologie Intersettoriali di Base. Oct 1988. 19p. Order Number DE89761990/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

This report contains two papers dealing with giant electric multipole resonances. Included in the 1987 progress report of Italian nuclear theoreticians, the theoretical analyses lie within the framework of the direct-semidirect model for nuclear radiative capture and the interacting boson model for photonuclear reactions. Specifically, the first compares the shell model and phenomenologic approaches to particle-vibrations coupling in the direct-semidirect model of radiative capture of fast nucleons and evaluates effects on the determination of measurable quantities. The second deals with the fragmentation of the giant dipole resonance in an algebraic model.

43942 (GSI–89-45(prepr.)) **Relativistic effects in molecular dynamics simulations of heavy-ion collisions.** Schmidt, R.; Kaempfer, B.; Feldmeier, H.; Knospe, O. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.). May 1989. 10p. Available from Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.).

We compare the results of a non-relativistic molecular dynamics simulation with that of an approximate relativistic one which is Lorentz-invariant up to order $(v/c)^2$. We find a drastic increase of the transverse flow caused by the momentum dependence of the relativistic forces. In addition the relativistic retardation effect is clearly seen in time evolution of the mean multiplicity of clusters. (orig.).

43943 (INIS-mf–11503, pp. 8-10) **Magnetic moments of excited states in fission products.** Wolf, A. (Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center). Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar

1989). In *Annual Meeting 1989*. Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
Transactions.; V. 15.
Summary only.

43944 (INIS-mf–11503, pp. 28-30) **Cluster model for the nucleus.** Ronen, Y. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering). Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989*. Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
Transactions.; V. 15.
Summary only.

43945 (INIS-mf–11503, pp. 51-52) **On the contributions of high level neutron inelastic scattering to the tritium breeding in lithium-7.** Ofek, R. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering); Tsechanski, A.; Shani, G. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989*. Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
Transactions.; V. 15.
Summary only.

43946 (INIS-SU–96, pp. 61-63) **Spin and relativistic deuteron.** Golovina, L.V. (Kujbyshevskij Gosudarstvennyj Univ., Kuibyshev (USSR)); Krutov, A.F.; Troitskij, V.E. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.
Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).
The contribution of relativistic spin flip effect into electromagnetic deuteron structure is calculated. It is shown that this effect results in considerable reconstruction of quadrupole form factor and deuteron polarization $T(Q^2)$ in the diffraction minimum region. Spin flip slightly contributes to the charge and magnetic form factors. 4 refs.; 2 figs.

43947 (INIS-SU–96, pp. 67-69) **Exactly solved deuteron model and relativistic impulse approximation.** Belyantsev, I.I. (Kharkovskij Gosudarstvennyj Univ., Kharkov (Ukrainian SSR)); Kostin, R.L.; Trubnikov, S.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.
Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).
Within the framework of exactly solved deuteron model analytical expression for deuteron nonrelativistic structure functions are determined. On the basis of these formulae relativization of the structure functions is carried out. 3 refs.; 2 figs.

43948 (INIS-SU–96, pp. 99-101) **Redistribution of charge density in isotopes in 1 $g_9$2/subshell filling by neutrons.** Kuprikov, V.I. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Soznik, A.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.
Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).
On the basis of Hartree-Fock method with effective Skyrme interaction charge distribution density variations in Ge, Se, Kr and Sr isotopes are studied. The effect of nucleon electromagnetic structure and dynamic quadrupole nuclear deformation on redistribution of charge density in these isotopes. It is shown that the sutrface layer thickness of charge density distribution in the isotopes decreases with 1 $g_9$2/subshell filling by neutrons. 11 refs.; 1 tab.

43949 (INIS-SU–96, pp. 29-32) **On systematic differences in measurements of differential cross section of the $\gamma p \rightarrow N\pi$ reactions in the range of first resonance.** Omelaenko, A.S. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.
Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).
Within the framework of phenomenological resonance model the existing experimental data on pion photoproduction reactions on a proton in the first nucleon resonance range are described. Normalization factors different for some measured differential cross sections are estimated and an aspect concerning self-consistency of some polarization data is discussed. 10 refs.; 2 figs.; 2 tabs.

43950 (INIS-SU–96, pp. 33-35) **Energy independent multipole analysis of pion photoproduction on proton in the range of first nucleon resonance.** Omelaenko, A.S. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.
Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).
For reactions of pion photoproduction on proton in the range of first nucleon resonance the energy independent multipole analysis including $E_{2(sup-)}{}^1$, $M_{2(sup-)}{}^1$ d-wave amplitudes into the number of determined multipoles is carried out. The results are compared with a new s-, p-wave analysis performed with the same experimental material. 9 refs.; 1 fig.; 1 tab.

43951 (INIS-SU–96, pp. 36-37) **Inverse pion electroproduction in isobar model: numerical analysis.** Mosolov, V.A. (Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR)); Smirnov, G.I.; Shumejko, N.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.
Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).
The results of numerical calculations of cross sections of inverse pion electroproduction in the isobar model, which can be used for analyzing the experimental data in the W <or approx. 1.5 GeV range to determine either nucleon form factors or those of resonances in the range of small time-like transferred momenta. 7 refs.; 1 fig.

43952 (INIS-SU–96, pp. 40-48) **Deuterium target with tensor polarization in electromagnetic interactions.** Rekalo, M.P. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Gakh, G.I.; Rekalo, A.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.
Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).
The general dependence of cross sections of inclusive and exclusive γd- and ed-interactions on tensor polarization of the target is elucidated. Analysis is carried out for formalism of structure functions. Asymmetry properties caused by tensor polarization of the target for the impulse approximation are established. Numerical estimations of a number of asymmetries for α-vector(e,e'p)n process are carried out on the basis of a relativistic version of the impulse approximation. 20 refs.; 7 figs.

43953 (INIS-SU–96, pp. 51-54) **Disintegration of vector-polarized deuteron by longitudinally polarized electrons and form factors G_{En}.** Rekalo, M.P. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Gakh, G.I.; Rekalo, A.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

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Sensitivity to electric form factor G_{En} of a neutron of polarization observables in the d-vector(e-vector, e'p)n reaction in the model of relativistic impulse approximation is studied. The effect of different uncertainties (freedom in the choice of a deuteron wave function, experimental data errors for neutron magnetic form factor in the range of medium and large values of transferred 4-momentum squared) on the possibility of G_{En} determination is studied. The method for determining neutron electric form factor G_{En} on the basis of polarizaion observables in the reaction of vector-polarized deuteron target disintegration by longitudinally polarized electrons in the exclusive d-vector(e-vector, e'p)n experiment in the quasielastic scattering region is the least model-dependent one. 6 refs.; 2 figs.

43954 (INIS-SU–96, pp. 59-61) **Determination of magnetic structure functions in electron scattering on deuteron at q^2=0.7...1.2 GeV^2.** Titov, Yu.I. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Kasatkin, Yu.A.; Akhmerov, R.V.; Esaulov, A.S.; Nagornyj, S.I.; Smelov, E.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

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The magnetic structure function (SF) of deuteron electrodisintegration was determined and its behaviour was explained. The necessary SF values were determined by two-dimensional interpolation of experimental data for 8 deg scattering angle. 5 refs.; 2 figs.

43955 (INIS-SU–96, pp. 64-66) **Off-mass effect of deuteron relativistic wave function and electromagnetic nucleon vertex in the D(e, e'p)n reaction.** Tokarev, M.V. (Tashkentskij Gosudarstvennyj Univ., Tashkent (USSR)). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

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Within the framework of Feynman covariant formalism the D(e,e'p)n reaction is considered. The influence of off-mass effect of deuteron relativistic wave function and electromagnetic nucleon vertex on possible cross section factorization is studied. In impulse approximation the contributions of direct and interference t- and u-channel amplitudes into the process cross section are calculated. 8 refs.; 1 fig.

43956 (INIS-SU–96, pp. 70-72) **Different parametrizations of nucleon electromagnetic current and deuteron electrodisintegration near the threshold.** Afanas'ev, A.V. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Rekalo, M.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

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Electromagnetic form factors and differential cross section of $e^- + d \rightarrow e^- + n + p$ process near the threshold are calculated. Sensitivity of these values to the choice of deuteron wave functions and parametrization of nucleon electromagnetic current outside the mass surface is studied. 10 refs.; 2 figs.

43957 (INIS-SU–96, pp. 72-77) **Deuteron structure in photo- and electrodisintegration reactions.** Kasatkin, Yu.A. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Nagornyj, S.I.; Inopin, E.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

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On the basis of covariant approach structure effects in deuteron photo- and electrodisintegration reactions are analyzed. In photodisintegration reactions attention is paid to gauge invariant accounting for the deuteron structure and investigation of the role of nucleon electromagnetic form factors. In reactions with electrons the near-threshold region of deuteron breakup is investigated. 16 refs.; 2 figs.

43958 (INIS-SU–96, pp. 78-81) **Masking of quark effects in NN interaction and in electron-nucleus scattering.** Obukhovskij, I.T. (Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki); Kusainov, A.M.; Neudachin, V.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

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It is shown in electron scattering on lightest nuclei at high transferred momenta and low excitation energies the contribution into the cross section of the six-quark component is considerably masked by destructive interference of diagonal 6q reversible 6q and nondiagonal NN reversible 6 q transitions. As a result, the dramatic discrepancy between new data on magnetic scattering and hybrid model predictions is eliminated. 17 refs.; 3 figs.; 1 tab.

43959 (INIS-SU–96, pp. 88-90) **Conservation of electromagnetic current and deuteron structure in covariant approach to the $\gamma d \rightarrow pn$ reaction.** Barannik, V.P. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Kulish, Yu.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

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In the covariant approach for electromagnetic current a set of gradient-invariant pole amplitudes of the $\gamma d \rightarrow pn$ reaction is determined. The dnp-vertex form factors expressed in terms of deuteron relativistic wave functions, corresponding to different diagrams, depend on their variables. The $\gamma d \rightarrow pn$ calculated cross sections in the case of linearly polarized photons are compared with the experimental data in the energy range below the pion production threshold. 15 refs.; 2 figs.

43960 (INIS-SU–96, pp. 83-85) **Description of the d(e,e'p)n reaction with account of meson exchange currents and FSI effects.** Korchin, A.Yu. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Mel'nik, Yu.P.; Shebeko, A.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number

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Within the framework of nonrelativistic approach a combined effect of meson exchange currents (MEC) and final-state interactions on formation of angular proton distributions in the d(e,e'p)n reaction is studied. Great attention is paid to matching of the MEC designs to realistic NN-interaction. The calculated cross sections of e'p coincidences are compared with the measured ones under conditions of different experimental kinematics in Saclay. 9 refs.; 5 figs.

43961 (INIS-SU–96, pp. 86-87) **Proton polarization in the d(e,e'p-vector)n reaction and effects of NN interaction.** Korchin, A.Yu. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Mel'nik, Yu.P.; Shebeko, A.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).

Within the framework of nonrelativistic approach proton polarization sensitivity in the d(e,e'p-vector)n reaction to inconsistency in the studied models of meson exchange currents and interactions in the np-system is investigated. The predicted polarization values are available for measurements. An experiment for studying interference of longitudinal and transverse components of deuteron electromagnetic current is proposed. 5 refs.; 2 figs.

43962 (INIS-SU–96, pp. 90-92) **Multipole analysis of deuteron photodisintegration at photon energy up to 600 MeV.** Barannik, V.P. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Kulish, Yu.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

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The multipole analysis of the γd -> pn process is carried out on the basis of experimental data on $d\sigma/d\Omega$, Σ asymmetry, proton polarization of P and T asymmteries caused by deuteron vector polarization at photon energy from 250 to 600 MeV ($2.11 \leq \sqrt{S} \leq 2.40$ GeV). The deuteron photodisintegration amplitudes are determined by contributions of three parts: a set of gradient-invariant pole amplitudes taking into account the deuteron structure, phenomenological amplitudes of pion photoproduction on nucleons and dibaryon resonances. It is shown that the x^2/df functional depends on sets of dibaryon resonances much stronger than on the used deuteron wave functions. 10 refs.; 3 figs.; 1 tab.

43963 (INIS-SU–96, pp. 93-94) **Deuteron photodisintegration in the model with realistic potential and minimal electromagnetic coupling.** L'vov, A.I. (AN SSSR, Moscow (USSR). Fizicheskij Inst.). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

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The γd -> pn reaction cross sections are calculated in the model, where the contribution of the Paris NN potential into the total retained electromagnetic current is taken into account by minimal replacement p -> p-eA. The calculated results are close to the standard data explicitly including meson exchange currents. 8 refs.; 4 figs.

43964 (INIS-SU–96, pp. 95-96) **Asymmetry in the γ-vectord -> γnp reaction and neutron polarizability.** Levchuk, M.I. (AN Belorusskoj SSR, Minsk (Byelorussian SSR). Inst. Fiziki); L'vov, A.I.; Petrun'kin, V.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

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It is shown that α_n and β_n neutron polarizabilities can be determined by measuring asymmetry in the γ-vectord -> γnp reaction with linearly polarized photons with 10-20% accuracy. The reaction cross section asymmetry is calculated in impulse approximation with distorted waves taking into account the contribution by meson exchange currents. 4 refs.; 1 fig.

43965 (INIS-SU–96, pp. 96-97) **Neutron polarizability and meson currents in the γd -> γnp reaction.** Levchuk, M.I. (AN Belorusskoj SSR, Minsk (Byelorussian SSR). Inst. Fiziki); L'vov, A.I.; Petrun'kin, V.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

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The γd -> γnp reaction differential cross section is calculated at photon energy of 100 and 250 MeV in impulse approximation with distorted waves and taking into account meson exchange currents. It is shown that experimental investigation of this reaction in the neutron quasielastic peak region permits to obtain data on γ_n scattering cross section, neutron polarizabilities and $F_{\pi(sup0)}$ -> 2 γ constant sign. 7 refs.; 2 figs.

43966 (INIS-SU–96, pp. 89-99) **On effect of polarization interaction on low-energetic properties of pd-system.** L'vov, A.N. (AN SSSR, Moscow (USSR). Fizicheskij Inst.). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

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It is shown that variation of the extracted scattering length and low-energy radiation capture cross section due to the presence of proportionality r^{-4} polarization potential is negligible ($\sim 10^{-3}$). 4 refs.

43967 (INIS-SU–96, pp. 105-110) **Electron scattering on nuclei and charge transition density.** Gul'karov, I.S. (Tashkentskij Gosudarstvennyj Univ., Tashkent (USSR)). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

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Different methods for calculating charge densities of 1s-1p and 1d-2s-shell nuclei compared with model-independent densities and electron scattering form factors are proposed. The sum rules providing microscopic substantiation of macromodels are discussed. The neutron effect on static and transition charge densities of ^{16,18}O, ^{32,34}S, ^{40,48}Ca nuclei-isotopes is considered. 21 refs.; 4 figs.

43968 (INIS-SU–96, pp. 111-112) **On charge density distribution of ^{16,18}O, ^{32,34}S and ^{40,48}Ca isotope.** Gul'karov, I.S. (Tashkentskij Gosudarstvennyj Univ., Tashkent (USSR)); Pinkus, L.D. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

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The charge density distribution (CDD) of 1s-1p and 1d-2s-shell nuclei are calculated in the harmonic oscillator model taking into account proton finite dimensions and centre-of-mass motion effects. The population numbers n differ from 0 or 1, and they are determined on the basis of comparison of the calculated CDD values with the model-independent one. It is shown that the rho(0) decrease, when neutrons are added to the nucleus, is caused not only by the oscillator parameter increase, but also by the n population number growth. The CDD calculated and model-invariant data are in good agreement. 1 ref.; 1 tab.

43969 (INIS-SU–96, pp. 116-118) **Isoscalar giant dipole resonances of ^{16}O and ^{40}Ca nuclei.** Gul'karov, I.S. (Tashkentskij Politekhnicheskij Inst., Tashkent (USSR)); Mansurov, M.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

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Form factors and transition charge density (TCD) of giant dipole resonances of ^{16}O and ^{40}Ca nuclei, isospin-forbidden, are calculated on the basis of the sum rules taking into account centre-of-mass motion and modified Steinvedel-Jensen (SJ) model. The calculated results are compared with electron scattering form factors and model-independent (in case of ^{16}O) TCD. The SJ model is in good agreement with the experimental TCD. The reduced dipole resonance transitions with T=0 are rather negligible ($\sim 10^{-3}$ e^2Fm^2) and transition radii are twice as great as root-mean-squared values. 4 refs.; 1 tab.

43970 (INIS-SU–96, pp. 118-120) **Magnetic M1- and M3-transitions in ^7Li nucleus.** Romanov, V.A. (Khar'kovskij Gosudarstvennyj Univ., Kharkov (Ukrainian SSR)); Trubnikov, S.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

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On the basis of dt scattering phase the nonrelativistic total magnetic form factor $G_M{}^2(Q_2)$ of ^7Li nuclear ground state is calculated. The rms magnetic radius and magnetic octupole moment of this radius are determined. 9 refs.; 2 figs.

43971 (INIS-SU–96, pp. 122-123) **Calculations and comparison with experiment of electronuclear sum rules and question on nucleonless degrees of freedom.** Ehfros, V.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

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The sum rules (SR) calculated for the (e,e') reaction on ^3He, ^4He nuclei are compared with the experimental data. It is stated that the corresponding the nonweighted longitudinal SR permits to verify the standard common approach to nucleus description due to its model independence. Accurate calculation of the given SR is carried out on the basis of a wide set of realistic NN forces. 5 refs.

43972 (INIS-SU–98, pp. 54) **Study of the dependence of particle yield in the shadow minimum on the orientation of a compound nucleus vector shift in UO_2 crystal.** Bukharov, A.S.; Yuminov, O.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

Short Communication

43973 (INIS-SU–100, pp. 46-53) **Internal conversion coefficients for low energy transitions.** Band, I.M. (AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki); Listengarten, M.A.; Trzhaskovskaya, M.B. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

Relativistic electron wave functions are calculated taking into account the exchange including that with atomic electrons when calculating continuous spectrum wave functions, ICC are calculated for low energy (from 75eV to 2keV) transitions for which the dependence on the method of screening account is especially high. It is found that exchange account turing calculations of continuous spectrum wave functions changes ICC from 30% (the lowest energies) to 7-10% (transition energies close to 2 keV). The comparison of conversion ratios on the subshells with the experiment produces no opportunity now to check up whether the calculations have approached the experimental values due to high measurement error. 13 refs.; 3 tabs.

43974 (INIS-SU–100, pp. 57-63) **Calculations of the E0-conversion electronic factors.** Listengarten, M.A. (Leningradskij Gosudarstvennyj Univ., Leningrad (USSR)); Suslov, Yu.P. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

Using the self-consistent Hartree-Fock-Slater field electron factors of E0-conversion for $Z<36$ are calculated. Homogeneously charged spheric distribution and the distribution of the Fermi type are used as nucleus charge distribution. It is shown that the role of account of exchange and overlapping effects does not exceed 0,5%. 11 refs.; 3 figs.

43975 (INIS-SU–100, pp. 64-69) **Parameters of longitudinal polarization of the conversion electrons in M1(E-tilde1)-transitions.** Feresin, A.P. (Leningradskij Gosudarstvennyj Univ., Leningrad (USSR)); Listengarten, M.A. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The longitudinal polarization of conversion electrons in MI(E-tilde)-transitions is considered. The results of calculations for ^{175}Lu,343,4keV, ^{181}Ta,482keV transitions are presented. It is shown that the penetration effect changes up to 70% of conversion parameters value calculated with no respect to the above effect. 10 refs.; 2 tabs.

43976 (INIS-SU–100, pp. 70-75) **Inelastic electronic bridges in electromagnetic nuclear transitions.** Kolomiets, V.M. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij); Kondrat'ev, V.N. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

Corrections to the probability of retarded nuclear electromagnetic transitions conditioned by the excitation of the electron shell of the atom (inelastic electron bridge) are considered. The relation of the probability of transition across the inelastic bridge to the probability

of direct nuclear γ-transition is determined. Numeric estimates are made for the M4 transition in ^{93}Nb and ^{193}Ir nuclei. It is shown that the obtained estimates of the relative probability of γ-transition across the inelastic electron bridge agree well with the experimental values for ^{93}Nb and ^{193}Ir. 11 refs.

43977 (INIS-SU–100, pp. 76-81) **Hyperfine shifts of the X-ray levels, excited by internal conversion and subsequent electromagnetic cascade.** Rodionov, A.A. (AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki); Fedorov, V.V. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

Nonstatistical, unlike the case of photoexcitation, population of components of the superfine structure of the edge atom K-level is possible in the case of resolved K-capture and internal K-conversion. The X-ray K-line appearing in this case is shifted relative to the fluorescent line, the measurement of such shifts opens new possibilities as regards the determination of nuclear components. The pesent paper presents the theory of effect of superfine shift of X-ray X_1,X_2-lines excited during internal conversion on the arbitrary atom shell and its flollowing discharge by the electromagnetic cascade. 13 refs.

43978 (INIS-SU–100, pp. 54-56) **Ionization, associated with internal conversion.** Drukarev, E.G. (AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki); Trzhaskovskaya, M.B. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The ionization accompanying K and L conversion in the thulium atom at the maximum energy E=1.5 keV with respect to interaction in the final state is calculated. The calculation is of practical value for experiments measuring the neutrino mass. It is shown that the neglect of interaction in the final state would bring about several eV mass increase. 1 tab.

43979 (INIS-SU–100, pp. 104-107) **On the energy levels multiplicity for add nuclei in the region A=115-135.** Sergeenkov, Yu.V. (AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki). AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

When researching ^{125}Sb decay Mazets E,P noted that the energies of 6 ^{125}Te levels of 8 measured with the precision $<10^{-4}$ are multiple energies of the first excited state. This paper shows that the analogous picture is observed for a number of other odd Te,I,Xe,Cs nuclei whose level energies are determined with a rather high accuracy. The data for the levels with the energy <1000 keV are considered. The quantum value is connected with the first level energy and lies in the range 25-40 keV. 3 refs.; 3 figs.; 1 tab.

43980 (INIS-SU–100, pp. 118-120) **Two-nucleon correlations, refinement of the mechanism of pion-nuclear reactions.** Lantsev, I.A. (Novgorodskij Politekhnicheskij Inst., Novgorod (USSR)); Lysenko, I.V.; Ostroumov, V.I.; Pavlov, A.V. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

To clarify the problem of the differences in n,p distribution in nuclei and the establishment of mechanisms of pion interaction with two-nucleon correlations it is necessary to specify the ratio of yields of two fast protons, a neutron and a proton. The modern state of the problem is considered. The results obtained by the authors are analyzed. 4 refs.; 1 tab.

43981 (INIS-SU–100, pp. 146-151) **Realization of the gamma-resonance of natural width in the non-Moessbauer energy and temperature region.** Vysotskij, V.I. (Kievskij Gosudarstvennyj Univ., Kiev (Ukrainian SSR)); Kuz'min, R.N. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The possibility of a very sharp increase of resonance unenxpanded gamma-line probability (amplitude) in the range of high energies and temperatures due to the consequent account of nonlinear dynamics of the crystal lattice during intensive ultrasound excitation in a crystal is suggested and calculated. The estimates prove that using feasable ultrasonic crystal excitation at the frequency $\Omega\sim$10-100 MHz$<$H/h with the relative amplitude $\sigma\sim10^{-3}$ the increase in the probability of realization of natural gamma-resonance in the energy range E$>$300-400 keV by 100 and more times without line splitting and expansion as compared with the case of the conventional Moessbauer effect i.e. its increase from the $f<10^{-4}$ value (not permitting such a resonance) to the value $f^* \geq 10^{-2}$ permitting the realization of gamma resonance, for example, in the ^{149}Sm nucleus with E$\sim$350 keV, is possible. 6 refs.; 1 fig.

43982 (INIS-SU–100, pp. 108-114) **Characteristic of the deformed nuclei beta- and gamma bands.** Grigor'ev, E.P. (Leningradskij Gosudarstvennyj Univ., Leningrad (USSR)). AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The energies of rotational levels in γ-bands and E2 transition probabilities in ^{156,162}Dy, ^{152}Sm, ^{164}Gd, ^{158,164,166}Er, ^{166,170}Yb nuclei are analyzed. The cases of closely located levels with similar spins and parities and their mutual effect are noted. It is shown that the knowledge of precise energy values permits to predict the position of levels in a band. 4 refs; 3 figs.; 1 tab.

43983 (INIS-SU–100, pp. 115-117) **Peculiarities of the octupole bands in thorium nuclei.** Grigor'ev, E.P. (Leningradskij Gosudarstvennyj Univ., Leningrad (USSR)); Gomes Saunders, M. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The levels of "long" bands in even-even thorium isotopes were excited. The energy decrease of the first excited levels and nucleus deformation increase with the growth of neutron number was established. The bands with negative parity in a number of heavy elements are located very low. This brings about the assumption on the static octupole deformation of such nuclei. Rotation (or quasirotation) levels in thorium isotopes are considered. It has shown that the inversion of 0^- and 1^- levels takes place. 1 ref.; 2 tabs.

43984 (INP–1302/PS, pp. 47-72) **Shape and electric-quadrupole moments at high-spin states.** Hamamoto, I. (Lund Inst. of Tech. (Sweden). Dept. of Mathematical Physics). Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89012206/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

Electric quadrupole matrix-elements of rotating nuclei are investigated in connection with the possible triaxial shape at high spin. It is shown that the signature dependence of the $\Delta I=1$ E2 transition rates in odd-A nuclei indicates the deviation of nuclear shape from axial-symmetry. Comments are made on the importance of taking into account of the wobbling motion in the analysis of measured quadrupole matrix-elements, especially for small angular-momentum and for small γ-values. 26 refs., 9 figs. (author).

43985 (INP–1302/PS, pp. 142-163) **Test of nuclear models with neutron-rich nuclei.** Sistemich, K. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

The spectroscopy of fission products provides unique possibilities to test several nuclear models. Thus one of the rare doubly magic nuclei, $_{50}{}^{132}Sn_{82}$, belongs to the neutron-rich isotopes and its study allows the test of the shell model at medium masses and far from stability. The nuclei at A $\sim$ 100 are influenced by subshells and deformation-driving forces. A rapid transition from spherical to deformed shapes can be studied. In this report some investigations are discussed which were performed at the fission-product separator JOSEF, or where members of the JOSEF group have contributed. Evidence has been obtained for strong shell closures at ^{132}Sn. In the A $\sim$ 100 region it was found that high-lying levels in ^{97}Y have single-particle character while ^{99}Y exhibits all properties of a symmetric rotor. This is of special interest since both the experimental knowledge on even-even nuclei and theoretical predictions indicate complex structures (e.g. shape coexistence and asymmetries) as well as softness against deformation for the immediate neighbours. 58 refs., 11 figs., 1 tab. (author).

43986 (INP–1302/PS, pp. 218-235) **New regions of nuclear deformation.** Lister, C.J. (Manchester Univ. (UK). Dept. of Physics); Varley, B.J. Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

It has long been expected from general theoretical considerations that nuclei with Z and N far removed from major shell closures should exhibit considerable collectivity and may be deformed in their groundstates. A number of calculations have recently attempted to quantify these expectations through detailed predictions of nuclear shapes across the periodic table. In this contribution we review predictions and experimental data for the regions with (Z,N)$\sim$(40,40) and (64,64) which are well off the valley of stability. Emphasis is placed on new results from the light rare earth region where evidence for axially symmetric nuclei with E>0.3 has been found. 24 refs., 9 figs., 2 tabs. (author).

43987 (INP–1302/PS, pp. 278-280) **Scission-point model of nuclear fission.** Moreau, J. (Ghent Rijksuniversiteit (Belgium). Lab. voor Kernfysica); Heyde, K.; Waroquier, M.; Isacker, P. van; Jolie, J.; Ryckebusch, J. Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

Experimental data and calculated values for the mass distribution in the fission of ^{235}U is compared. Various discrepancies between theoretical calculations and experimental results on mass and kinetic energy distributions indicate that the collective kinetic energy at the scission point is certainly not independent of the various collective degrees of freedom. In order to obtain the precise relation, the dynamic aspects of the fission process and associated intrinsic excitation energy is studied. 5 refs., 2 figs. (L.I.).

43988 (INP–1302/PS, pp. 324-328) **Residual neutron-proton interaction in rotating odd-odd rare earth nuclei.** Frisk, H. (Lund Inst. of Tech. (Sweden). Dept. of Building Technology). Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

The GM-splitting and the Newby-shift are calculated. A few examples where several spin states have been observed in both members of the Gallagher-Moszkowski doublet are compared and illustration of possible effects caused by the residual interaction calculated. Two quasiparticle Routhians of two different $[h_{11}2/]_p[i_{13}2/]_n$ configurations are shortly described. 8 refs., 3 figs. (L.I.).

43989 (INP–1302/PS, pp. 331-345) **Superdeformation of fast rotating nuclei.** Blocki, J. (Institute for Nuclear Studies, Otwock-Swierk (Poland)). Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

Calculation within Liquid Drop Model (LDM) leading to the stable superdeformed shapes of light nuclei are shown. Possible ways of deexcitation of these nuclei formed in Heavy Ion Collisions are discussed. In addition calculations using folding potential and their comparison with a LDM idealization are also presented. 15 refs., 5 figs., 1 tab. (author).

43990 (INP–1302/PS, pp. 356-361) **Study of the σtau$_+$ strength in ^{148}Tb in the framework of the Quasiparticle-Random-Phase Approximation (QRPA).** Conci, C. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

The σtau$_+$ strength in the nucleus ^{148}Tb using the Quasiparticle-Random-Phase Approximation is studied. It is investigated how and how much conventional nuclear structure effects , like pairing effect and ground state correlations can account for the missing GT$^+$ strength. 7 refs., 1 fig. (author).

43991 (INP–1302/PS, pp. 398-412) **Nuclear collective motion within the generator coordinate method.** Gozdz, A. (Regensburg Univ. (Germany, F.R.). Naturwissenschaftliche Fakultaet 2 - Physik); Pomorski, K.; Brack, M.; Werner, E. Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

The generator coordinate method (GCM) and the Gaussian approximation for the overlap (GOA) of generating functions are used to multidimensional collective vibrations. The proper collective Schroedinger equation is derived, starting from a mean field potential depending on some collective parameters and including a residual pairing interaction. The mass parameters for the shape vibrations estimated in the cranking and in the GCM approximations are compared. It is also shown that within GCM + GOA method it is relatively simple to restore the broken symmetries, e.g. the approximate projection for good particle number and angular momentum of the BCS vawe function. 15 refs., 7 figs. (M.F.W.).

43992 (INP–1302/PS, pp. 394-397) **Spontaneous fission half-life-times for double-odd actinide nuclei.** Lojewski, Z. (Uniwersytet Marii Curie-Sklodowskiej, Lublin (Poland). Inst. Fizyki); Baran, A. Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

A hidrance factor H is calculated for actinide nuclei (A≥242). Spontaneous fission half-life times for double odd actinide nuclei are shown. The calculated results are compared with experimental data. 4 refs., 6 figs. (M.F.W.).

43993 (INP–1302/PS, pp. 417-423) **On the interpretation of monopole interacting Boson Model (IBM) bosons in terms of the collective pairing field.** Szpikowski, S. (Uniwersytet Marii Curie-Sklodowskiej, Lublin (Poland). Inst. Fizyki); Zajac, K. Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, Zakopane (Poland), 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

It has been already recognized that the quadrupol bosons (d-bosons) are connected to the quadrupol phonons of the collective nuclear model of Bohr and Mottelson. The scalar s-bosons, on the other hand, seem to be the building blocks for description of the microscopic pairing interaction. The seminar is devoted to show, in an explicite way, such a connection. 12 refs., 1 fig. (author).

43994 (ITP–87-156) **Vertex constant of T->d+n in a two-body potential approach.** Petrov, N.M. AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Teoreticheskoj Fiziki. 1988. 8p. Order Number DE89634637/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The nuclear vertex constant G^2_{Tdn} is calculated within the two-body potential theory. To describe the nd-interaction the use is made of the Hulten potential whose parameters are consistent with triton binding energy E_T and doublet nd-scattering length A_2 corresponding to different nucleon-nucleon potentials. For the majority of NN-potentials a good quantitative agreement of the value G^2_{Tdn} calculated in a two-body potential model with the same value found from the solution of exact three-particle equations is obtained. The values of the vertex constant G^2_{Tdn} and the asymptotic parameter G^2_T corresponding to experimental triton binding energy and the doublet nd-scattering length are defined. 23 refs.; 1 tab.

43995 (JINR-N–6(32)-88, pp. 17-21) **Nuclear structure functions in the boundary region of the single-particle kinematics.** Kaptar', L.P.; Umnikov, A.Yu. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. In *JINR rapid communications. Collection of papers.* Order Number DE89012205/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

A theoretical analysis of nuclear functions in the region x~1 is given. It is shown that the contributions of pure nucleons and multiquak components of the nuclear wave function in this region are comparable and the binding effects and Q^2-evolution lead to softening of the quark distributions in nucleus. Numerical predictions for the carbon structure function in the cumulative region were made. 9 refs,; 2 figs.

43996 (JINR-N–6(32)-88, pp. 11-16) **Space-time picture of deep inelastic lepton-nucleus collisions.** Eliseev, S.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics); Kamal, M.; El-Naghy, A. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). In *JINR rapid communications. Collection of papers.* Order Number DE89012205/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Space-time characteristics of inelastic intranuclear interactions are determined by analysing νE_m collisions at high energies. Particular attention is given to the new data obtained at the hybrid emulsion spectrometer earlier used for studying the production cross sections and lifetimes of charmed particles. 8 refs.; 6 figs.

43997 (JINR-R–4-88-539) **Static deformation of atomic nuclei and giant quadrupole resonance.** Bal'butsev, E.B.; Molodtsova, I.V. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 10p. (In Russian). Order Number DE89634622/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the journal Yad. Fiz.

The energies and probabilities B(E2)-factors of giant quadrupole resonances (GQR) in dependence on deformation are calculated in the framework of the method of moments. Splitting of GQR energy obtained here is in good agreement with the experimental values of broadening of CQR. The leading role of operator of kinetic energy in originating of static deformation of atomic nuclei is demonstrated. 11 refs.; 2 figs.; 1 tab.; submitted to the journal Yad. Fiz.

43998 (Juel-Spez–486) **Elastic K^+-nucleus scattering with a microscopical K^+-nucleon t-matrix.** Wyborny, P. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik. Dec 1988. 118p. (In German). Order Number DE89796018/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The elastic scattering of K^+-mesons from nuclei is studied to access the possibility of a hadronic scale change in nuclear matter. The K^+-meson is the appropriate probe for such studies because of its large mean free path of $\simeq$ 7 fm in nuclei. The total and the elastic differential cross sections are calculated for the reactions K^+-deuteron, K^+-^{12}C and K^+-^{40}Ca at various incident energies (450 MeV/c $\leq p_{lab} \leq$ 800 MeV/c) using an optical potential which was constructed in lowest order multiple scattering theory (t_ρ-factorisation in momentum space). The density p was taken from electron-scattering experiments corrected for the finit size of the proton. The (K^+-N) t-matrix was constructed by Buettgen and Holinde. The off-shell behavior of the microscopic K^+-N t-matrix is examined. Using this microscopic K^+-N t-matrix in the construction of the K^+-nucleus optical potential we get an excellent description of total and elastic differential cross sections for deuteron, ^{12}C and ^{40}Ca. We also obtain a good description of the measured ratio $\sigma^{K\pm 12c}$ total / $\sigma^{K\pm deuteron}$ total over a wide incident energy range. The reason for this good aggreement is due to a different interference pattern of the scattering phase shifts using experimental phase shifts or phase shifts calculated from microscopic meson exchange model. (orig.).

43999 (Lund-MPh–88/14) **An approximate method for calculating the deformation of rotating nuclei.** Lind, P. Lund Univ. (Sweden). Dept. of Mathematical Physics. 7 Nov 1988. 55p. Order Number DE89796487/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The author presents as a collective model where the potential surface at spin I=0 is calculated in the Nilsson-Strutinsky model, an analytical expression for the moment of inertia is used which depends on the deformation and the pairing gaps for protons and neutrons, and the energy is minimized with respect to these gaps. Calculations in this model are performed for ^{16}Oyb. (HSI).

44000 (RCNP-P–100) **Report of study meeting on giant resonance.** Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. 1988. 234p. (In Japanese). Order Number DE89906614/JAW. Available from NTIS (US Sales Only), PC A11/MF A01.

The research on the giant resonance of atomic nuclei taking the opportunity of the discovery of E2 giant resonance about 15 years ago has developed to the discovery of E0, E3 and E4 giant resonances, GT and MI resonances and others. The recent development seems to proceed toward the more basic understanding of the oscillation mode of atomic nuclei themselves through the research on giant resonance carried out so far. Taking the opportunity of the discovery of GT and MI resonances and others, the role of Δ nucleons in atomic nuclei has been actively discussed, and this is one of the good examples. In order to understand more comprehensively the behavior of nucleons in atomic nuclei and the nuclear force acting mutually on nucleons, it is effective to study on respective excitation modes after separating the response spectra of atomic nuclei into spin, isospin and exciting angular momentum. It is important also to search for a new excitation mode of atomic nuclei. In order to put the present status in order and to discuss the new direction of development about the giant resonance of atomic nuclei, the study meeting 'Giant resonance' was held on June 21 - 23, 1988 in the Nuclear Physics Research Center, Osaka University. In this report, the discussions and reports at the meeting are collected. (K.I.).

44001 **Predictions of $B(E2; 0^+_1 \rightarrow 2^+_1)$ values for even-even nuclei.** Raman, S. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831 (US)); Nestor, C. W. Jr.; Kahane, S.; Bhatt, K. H. *Atomic Data and Nuclear Data Tables (USA)*, 42(1): 1-54 (May 1989). DOE Contract AC05-84OR21400;AS05-76ER04936.

Adopted values (from a previous compilation) for the energy, *E*, and the reduced electric quadrupole transition probability, *B*(*E*2)↑, for the first-excited 2^+ state of 276 even-even nuclei are tabulated. The adopted *B*(*E*2)↑ values are employed to test the various systematic, empirical, and theoretical relationships that have been proposed to exist among these *B*(*E*2)↑ values on a global, local, or regional basis. On the basis of these systematics, predictions of unmeasured *B*(*E*2)↑ values for 181 additional nuclei are made in the tabulation. © 1989 Academic Press, Inc.

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Refer also to citation(s) 42482, 43561

44002 (AD-A–206209/9/XAB) **Stopping powers and mean excitation energies of the transition metals from iron to zinc.** Sabin, J.R. Florida Univ., Gainesville, FL (USA). Quantum Theory Project. 1 Feb 1989. 9p. Available from NTIS, PC A02/MF A01.

Pub. in Physical Review A, Vol. 39, No. 3, 1033-1040(1 Feb 1989).

The Z 2-1 dependent (Bethe) stopping powers of metallic Fe, Co, Ni, Cu, and Zn targets for protons in the energy range 2 keV < Ep< 100 MeV are calculated using the kinetic theory of stopping. The necessary electron velocity distributions are obtained from measured solid-state Compton profiles. The mean excitation energies are obtained by matching the calculated stopping curves to experimental data in the projectile energy range 1 MeV < Ep < 30 MeV, a range where the projectile velocity is too large for deviations from Bethe stopping to be important, and too small for relativistic corrections to be unimportant. The results obtained in this manner yield stopping curves that agree quantitatively with experimental measurements in the whole projectile energy region where Bethe theory should be valid, and which behave in the expected manner outside this region. It is demonstrate that the decomposition of the mean excitation energy into orbital contributions is important for determination of the stopping cross section. We conclude that assigning different orbital mean excitation energies to different shells leads to rather large modifications of the commonly accepted total mean excitation energy.

44003 (AECL–9185) **Analysis of neutron small angle scattering data for molecules of arbitrary shape.** Ahmed, F.U.; Martel, P. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Oct 1986. 28p. Order Number DE89634618/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The spherical modification of the Debye method proposed by Glatter has been programmed to analyze small angle neutron scattering (SANS) data in terms of various complicated molecular shapes. In the calculational procedure the molecule is simulated by a large number of overlapping small spheres which fill the space occupied by the molecule. A technique is described for fitting the resolution-broadened model scattering function to experiment by varying selected model parameters and normalization factors so as to obtain the best fit (minimum chi^2). At each stage of iterative procedure the radius of gyration is computed. When the model shape can be represented by a combination of simple analytic forms the program itself defines the coordinates and radii of the small spheres and automatically minimizes boundary effects. If this representation cannot be made then the user must specify the coordinates and radii of the small spheres as well as their number lying within the specified boundaries of the model shape. This report gives a description of the program (COBRA) and directions for its use.

44004 (DOE/ER/03342–1) **Low temperature and neutron physics studies: Final progress report, March 1, 1986–May 31, 1987.** Shull, C.G. Massachusetts Inst. of Tech., Cambridge, MA (USA). Dept. of Physics. 27 Jul 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER03342. Order Number DE89016660/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A search for a novel coupling interaction between the Pendelloesung periodicity which is formed in a diffracting crystal and the Larmor precession of neutrons in a magnetic field has been carried out. This interaction is expected to exhibit a resonant behavior when the two spatial periodicities become matched upon scanning the magnetic field being applied to the crystal. Observations on a diffracting, perfect crystal of silicon with neutrons of wavelength 1 Angstrom show the expected resonant action but some discrepancy between the observed magnitude of the resonance effects remains for interpretation. 16 refs.

44005 (ENEA-RT-FUS–85-1) **Neutron streaming through an iron duct: comparison of measured and calculated neutron and gamma-ray energy spectra using Monte Carlo MORSE and MCNP codes. A benchmark experiment proposal.** Batistoni, P.; Bertalot, L.; Martone, M.; Pillon, M. ENEA, Rome (Italy). May 1985. 28p. Order Number DE89761998/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Contribution of ENEA to the European Fusion Technology Program Task B3 (Neutronics Benchmark Experiment), Frascati (Italy) 13-15 Dec 1984.

The shielding problem for a fusion reactor could, in principle, be similar to the fission reactor problem solved thirty years ago. Nevertheless, the large difference in the energy of neutrons (14 MeV for fusion, about 1 MeV for fission) requires, in connection with the shield design for a fusion reactor, improvement in the present calculation methods and key experiments in order to gain confidence in these calculations. This report presents the proposal of a neutron streaming experiment, to be used as a benchmark to test neutron code calculation. As measured by R.T. Santoro, neutron and gamma-ray energy spectra, resulting from the streaming of 14 MeV neutrons through a 0.3 m/diameter iron duct, are compared with spectra calculated by the use of 3-D Monte Carlo MORSE and MCNP codes.

44006 (FEI–1890) **Conjugation of solenoids of radiation transport equation in the problems of radiation protection calculation. Method and algorithms.** Korobejnikov, V.V.; Baranov, O.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1988. 28p. (In Russian). Order Number DE89632244/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Methods for calculating nonuniform shield sections using successive application of programs with different types of accuracy are considered. Main attention is paid to combinations of finite-difference methods of calculation with statistical ones. Bands of solutions both with application of adjoint function and without it are considered. Various methods for construction and simulation of a surface source are considered as well. 13 refs.; 10 figs.

44007 (INIS-mf–11483, pp. 9) **Calculation of coefficients for parametric expression of gamma ray dose build-up factors.** Pickschneider, J. (VEB Bergmann Borsig, Berlin (German Democratic Republic)). Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

44008 (INIS-mf–11503, pp. 34-35) **Generation of expressions for high order elements of the neutron scattering transformation matrices.** Ofek, R. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering). Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Summary only.

44009 (INIS-SU–103/A) **Quantum radiophysics. Collection.** Kratkie soobshcheniya po fizike. No. 12. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. 65p. (In Russian). Order Number DE89012203/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Individual papers in this collection are separately indexed.

44010 (JAERI–1316) **RADHEAT-V4: a code system to generate multigroup constants and analyze radiation transport for shielding safety evaluation.** Yamano, Naoki; Minami, Kazuyoshi; Koyama, Kinji; Naito, Yoshitaka. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1989. 315p. Order Number DE89906496/JAW. Available from NTIS (US Sales Only), PC A14/MF A01.

A modular code system RADHEAT-V4 has been developed for performing precisely neutron and photon transport analyses, and shielding safety evaluations. The system consists of the functional modules for producing coupled multi-group neutron and photon cross section sets, for analyzing the neutron and photon transport, and for calculating the atom displacement and the energy deposition due to radiations in nuclear reactor or shielding material. A precise method named Direct Angular Representation (DAR) has been developed for eliminating an error associated with the method of the finite Legendre expansion in evaluating angular distributions of cross sections and radiation fluxes. The DAR method implemented in the code system has been described in detail. To evaluate the accuracy and applicability of the code system, some test calculations on strong anisotropy problems have been performed. From the results, it has been concluded that RADHEAT-V4 is successfully applicable to evaluating shielding problems accurately for fission and fusion reactors and radiation sources. The method employed in the code system is very effective in eliminating negative values and oscillations of angular fluxes in a medium having an anisotropic source or strong streaming. Definitions of the input data required in various options of the code system and the sample problems are also presented. (author).

44011 (KEK–88-9) **Proceedings of the workshop on neutron scattering research with intense spallation neutron source 'today and tommorrow'. First meeting of Japan-UK collaboration in neutron scattering research.** Watanabe, N.; Arai, M.; Endoh, Y. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. V (CONF-8710488–: Workshop on neutron scattering research with intense spallation neutron source, 6-7 Oct 1987). Order Number DE89906380/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Individual papers in these proceedings are indexed separately.

44012 (ORNL/FTR–3336) **[Neutron scattering experiments at the Institut Laue-Langevin, Grenoble, France and at the Rutherford Appleton Laboratory, Didcot, England, June 12–July 9, 1989]: Foreign trip report.** Mook, H.A. Jr. Oak Ridge National Lab., TN (USA). 24 Jul 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015398/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Neutron scattering gives direct information about properties of condensed matter that can be obtained in no other way. At this time and for the foreseeable future, the best neutron scattering facilities are in Europe. The best reactor source is at the ILL, while ISIS, the best pulsed source, is at RAL. The reactor source is more versatile, but the pulsed source can be superior in specialized cases. This report contains an account of our studies on magnetism and superconductivity at the ILL and measurements to be made on the excitation spectra of iron at ISIS. At the ILL, we concentrated on the heavy fermion system UBe_{13}, but we also made measurements on the high-temperature superconductors. We were particularly interested in magnetic effects in the new electron-doped materials like $Pr_2(Ce)CuO_4$. The ISIS burned out a magnet and was not running at the time I was there, but we got the experiment set up, and it will be run as soon as the machine starts. We also made plans to do an experiment utilizing the muon precession apparatus (mSR) on the one-layer 2201 BiSrCuO superconductor.

44013 (PB–89-188809/XAB) **DCTDOS: neutron and gamma penetration in composite duct systems.** Spencer, L.V. National Bureau of Standards, Washington, DC (USA). Center for Radiation Research. Feb 1987. 93p. (NBSIR–87/3534). Available from NTIS, PC A05/MF A01.

The paper describes computer methods for estimating neutron and gamma-ray fluence rate, dose, and even spectral features due to penetration through a series of duct segments. The procedure links together data for individual segments – straight sections and bends – in arbitrary combinations; and the resulting composite can include computations for a room at the end, if there is one. This particular method was developed for rapid estimates in the protection problems against nuclear weapons, but the concepts employed are more broadly applicable.

44014 (PNL–6500-Pt.4, pp. 25-27) **Doubly differential ionization cross section for the intermediate-velocity heavy ions.** Toburen, L.H.; DuBois, R.D.; Goldhagen, P. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

For a complete description of the energy deposition by fast neutrons in tissue, one must understand the interaction process for charged-particle recoils including hydrogen, helium, carbon, oxygen and nitrogen ions. Although our primary emphasis has been on hydrogen and helium ions, the predominant particles induced by neutron reactions in tissue, we have also initiated measurements for carbon and oxygen ions. During the past year, analysis of data of the doubly differential cross sections for interaction of oxygen ions with water vapor molecules has continued. The data for ion energies from 1.3 to 3.3 MeV and charge states 1 to 3 enable a detailed study of the charge state dependents on electron emission cross sections. Cross sections are available for electron emission angles ranging from 15 to 130 degrees and ejected energies from a few eV to 1500 eV.

44015 (PNL–6500-Pt.4, pp. 29) **Ionization in small sites.** Wilson, W.E.; Metting, N.F.; Paretzke, H.G. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

Our treatment of the ionization and energy deposition in submicron sites produced by crossing protons was significantly reworked. A theoretical basis for the major part of the dependence on ion energy and site size was developed. Also, an analytical solution to an equation was discovered which obviated a requirement for a numerical solution. These improvements resulted in a more sound and concise algorithm for describing the distributions.

44016 (PNL–6500-Pt.4, pp. 29-30) **Microdosimetric aspects of 0.3- to 20-MeV proton tracks, I. crossers[a].** Wilson, W.E.; Metting, N.F.; Paretzke, H.G. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

Track structures of fast protons obtained by computer simulation using a detailed-history Monte Carlo method were evaluated to obtain stochastic frequency distributions for energy imparted and number of ionizations. These microdosimetric quantities were calculated for 0.3- to 20-MeV protons passing through spherical sites of 2 nm to 1 μm diameter in unit density water. From the distributions, the dependencies of their first two moments on ion energy, site size, and position of the track within the site were computed. The frequency distributions were fitted by simple analytical functions to fitted by simple analytical functions to facilitate their use in further microdosimetric considerations.

44017 (PNL–6500-Pt.4, pp. 30) **Analytic model for ionization distributions produced in nanometer volumes by recoil protons[a].** Wilson, W.E.; Paretzke, H.G. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

A concise mathematical model is presented for the microdosimetric ionization distributions produced in subcellular volumes by energetic protons of 0.3 to 20 MeV. The model is based on the results of extensive Monte Carlo computer simulations of high-LET charged particle tracks and can be used to estimate, with only a modest computing effort, straggling and delta-ray transport effects in the nanometer dosimetry of high-LET radiations.

44018 (PNL–6500-Pt.4, pp. 30) **Microdosimetric aspects of 0.3- to 20-MeV proton tracks. II. Touchers.** Wilson, W.E.; Paretzke, H.G. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

Protons that pass outside the site but which deposit energy via secondary electrons, so-called touchers, are significant events for very small sites inasmuch as nearly 50% of the stopping power is borne by delta-rays. Toucher-event modeling has focused on trying to discover the systematics of the ionization distributions. The probability for a nanometer site experiencing any ionization deposition was proportional to the solid angle of the site as seen from the ion path, and to the total ionization cross section, i.e., proportional to the number of delta-rays produced per unit path length. The data was scaled by the real trigonometric solid angle for near distances, various effective eccentricities were tried, and partial cross sections were used that realistically reflected the production of only those delta-rays capable of reaching the site. Some of the variations were helpful over small regions of the parameters, ion energy for example. But none, alone or collectively, produced universal simplicity or insight into the problem. The set of computed ionization distributions was inadequate for the task.

44019 A neutronic study of an accelerator-based neutron irradiation facility for boron neutron capture therapy. Wang, C.K.C. (9521095); Blue, T.E.; Gahbauer, R. *Nuclear Technology (USA),* 84(1): 93-107 (Jan 1989).

A neutronic study of an accelerator-based neutron irradiation facility (ANIF) for boron neutron capture therapy (BNCT) was performed using three-dimensional Monte Carlo transport calculations. The major components of the ANIF are a radio-frequency quadrupole proton accelerator, a ^{7}Li target, and a moderator assembly. Neutrons are generated by bombarding the ^{7}Li target with 2.5-MeV protons. The neutrons emerging from the ^{7}Li target are too energetic to be used for BNCT and must therefore be moderated. Calculations show that, among all materials for the ANIF, beryllia (BeO) and heavy water (D_2O) are the best moderators. Between them, beryllia provides better neutron spectra, but D_2O gives higher neutron intensities. Adding alumina (Al_2O_3) to D_2O improves the neutron spectra, but it also increases gamma-ray contamination.

44020 Fine-mesh limit of one-dimensional nodal transport equations. Gelbard, E.M. (9520850); Liu, Y.W.H.; Olvey, L. *Nuclear Science and Engineering (USA),* 101(2): 166-178 (Feb 1989).

Embedded in multidimensional nodal transport computations is the solution of transverse-integrated one-dimensional transport equations. Since, in these embedded one-dimensional computations, fluxes on boundaries are double P_1 DP_1, it is generally assumed that the one-dimensional solutions, in the small-mesh limit approach DP_1 solutions. It is shown that this is not necessarily true. Small-mesh limits of nodal equations are derived, and it is shown that these are substantially worse than the DP_1 equations under certain circumstances. Alternative nodal equations (which do have a DP_1 small-mesh limit) are proposed.

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Refer also to citation(s) 41766, 42070, 43222, 43223, 43233, 44019

44021 (CANMET–84-11E) **Lead-210 in certified uranium reference ores DL-1a, BL-4a, DH-1a and BL-5.** Smith, C.W.; Steger, H.F. Canada Centre for Mineral and Energy Technology, Ottawa, ON (Canada). Mining Research Labs. Dec 1984. 27p. Order Number DE89635402/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Lead-210 radioactivity in uranium reference ores BL-4a and BL-5 and uranium-thorium reference ores DL-1a and DH-1a was determined by an interlaboratory program. Ten of eleven participating laboratories employed Amersham Corporation certified ^{210}Pb solutions for calibration for measurements by gamma-ray spectrometry, beta-counting of ^{210}Bi or alpha spectrometry of ^{210}Po following radiochemical separations. No significant methodological bias was detected. Recommended values for ^{210}Pb activities and associated parameters were determined by statistical treatment of the results. The recommended values for the activity of ^{210}Pb are 1.40, 15.5, 30.8 and 866 Bq g^{-1} for DL-1a, BL-4a, DH-1a and BL-5, respectively. These values are consistent with secular equilibrium in the ^{238}U decay series in each material.

44022 (GSF–3/89) **Tomographic anthropomorphic models. Pt. 1. Construction technique and description of models of an 8 week old baby and a 7 year old child.** Veit, R.; Zankl, M.; Petoussi, N.; Mannweiler, E.; Drexler, G.; Williams, G. Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). 1989. 58p. Contract EG B16-F-133-D. Order Number DE89911154/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The first generation of heterogeneoeous anthropomorphic mathematical models to be used in dose calculations was the MIRD-5 adult phantom, followed by the pediatric MIRD-type phantoms and by the GSF sex-specific phantoms ADAM and EVA. A new generation of realistic anthropomorphic models is now introduced. The organs and tissues of these models consist of a well defined number of volume elements (voxels), derived from computer tomographic (CT) data; consequently, these models were named voxel or tomographic models. So far two voxel models of real patients are available: one of an 8 week old baby and of a 7 year old child. For simplicity, the model of the baby will be referred to as BABY and that of the child as CHILD. In chapter 1 a brief literature review is given on the existing mathematical models and their applications. The reasons that lead to the construction of the new CT models is discussed. In chapter 2 the technique is described which allows to convert any physical object into computer files to be used for dose calculations. The technique which produces three dimensional reconstructions of high resolution is discussed. In chapter 3 the main characteristics of the models of the baby and child are given. Tables of organ masses and volumes are presented together with three dimensional images of some organs and tissues. A special mention is given to the assessment of bone marrow distribution. Chapter 4 gives a short description of the Monte Carlo code used in conjunction with the models to calculate organ and tissue doses resulting from photon exposures. Some technical details concerning the computer files which describe the models are also given. (orig./HP).

44023 (IAE–4528/3) **Risk and safety discussed from system dynamics point of view.** Kuz'min, I.I.; Romanov, S.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1987. 28p. (In Russian). (T–18888). Order Number DE89635277/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

One of possible approaches to solution of the problem of optimizing espenditure for population protection is presented. The most general indeces of public health the total mortality coefficient and mean life time from burth-were used as the measure of safety. Technique, based on methods of system dynamics, quantitative estimation of technogenic risk and calculation of the maximal efficiency of expenditure for technical safety systems, is presented. 16 refs.; 8 figs.

44024 (INFO–0266) **'Alive' searches as complementing death searches in the epidemiological follow-up of Ontario miners.** Fair, M.E.; Newcombe, H.B.; Lalonde, P.; Poliquin, C. Atomic Energy Control Board, Ottawa, ON (Canada). Feb 1988. 47p. Order Number DE89635278/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

'Alive' searches have been used to complement the 'death' searches, in a study of the mortality experience of a cohort of Ontario miners. The purpose has been to develop a way of distinguishing between those cohort members who are 'confirmed' alive at a given time, and those who are 'lost to follow-up'. A total of 30,000 Workers' Compensation Board (WCB) records with valid Social Insurance Numbers (SIN) were used to search the income tax files by computer over two consecutive years (1977 and 1978) representing nearly 27 million tax returns. These tax file searches using SIN numbers have provided information on the procedures to be used in, and likely success of, the corresponding searches of the tax files that could be carried out where the SIN number is not available on the work records. The latter kind of search would have to be based on names, birth dates and such, and would be probabilistic in nature. The results of the study were as follows: After the

initial death search, it was found that 7.5% of the cohort had died in Canada and their records were found on the Mortality Data Base. The remaining 92.5% has been 'assumed alive' in the earlier analysis. After the 'alive' follow-up using the income tax file, one was able to confirm that 89.1% of the 'assumed alive' had filed an income tax after the study period. Thus only 3.4% of the cohort remained untraced. Among those there could be an admixture of deaths outside of Canada, persons who have moved outside of Canada and are still alive, and/or persons alive within Canada, but who have not filed an income tax return. This study has indicated that the procedures developed are useful for purposes of 'alive' follow-up, for evaluation of the quality of the Mortality Data Base-cohort death file searches, for improving the accuracy of analytical results of epidemiological studies, and for reducing the cost and labour of resolving doubtful death searches.

44025 (INFO–0269) **Morbidity follow-up feasibility study.** Carpenter, M. Atomic Energy Control Board, Ottawa, ON (Canada). Feb 1988. 38p. Order Number DE89635279/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The report reviews the available sources of data within Canada for undertaking morbidity follow-up studies to both supplement and complement studies using Canadian mortality data. Such studies would permit earlier detection and more sensitive measures of differences in risk for exposures to radiation and allow timely measures to be taken to minimize any occupational and environmental health risk to radiation workers. The technical feasibility of using these sources was reviewed using the criteria of adequate personal identifying information, automation of data records, file size and the accuracy of the morbidity diagnosis information. At the present time certain of the provincial cancer registry files meet these criteria best. A work plan was prepared suggesting a morbidity pilot study to clarify the role of occupational factors in the incidence of cancer among radiation workers using the Alberta Cancer Registry file and the National Dose Registry (NDR) file of radiation workers. For the longer term a full cohort study using the National Cancer Incidence Reporting System (NCIRS) and the NDR workers as the study population would provide information on all radiation workers on a national basis. A work plan was prepared and some initial format conversion of historical data was undertaken to begin developing the NCIRS into a data base suitable for long-term health studies.

44026 (INIS-mf–11483, pp. 4) **Establishing of a safety dose limit on the basis of the smallest detectable radiation risk.** Weber, K.H. (VEB Robotron Messelektronik Otto Schoen, Dresden (German Democratic Republic)). Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

44027 (INIS-mf–11483, pp. 5) **Occupational exposure to the personnel, regarded by to B category.** Gubatova, D. (Medical Institute, Riga (USSR)); Balode, G.; Nemiro, E. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

44028 (INIS-mf–11483, pp. 17) **Rn-222 in the air of underground mines in Slovenia, Yugoslavia.** Kobal, I. (Ljubljana Univ. (Yugoslavia)); Vaupotic, J.; Burger, J.; Udovc, H.; Stropnik, B. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

44029 (INIS-mf–11483, pp. 4) **Natural ionizing radiation: sources and measurement.** Stolz, W. (Bergakademie, Freiberg (German Democratic Republic). Sektion Physik); Gast, H.; Gellermann, R.; Hebert, D. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

44030 (INIS-mf–11483, pp. 9-10) **Neutron dose equivalent in the men body.** Alekseev, A.G. (Institute for High Energy Physics, Protvino (USA)); Golovachik, V.T.; Sannikov, A.V.; Savinsky, A.K. Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

44031 (INIS-mf–11483, pp. 2) **Consequences of the new atomic bomb survivor dosimetry on radiation risk estimates.** Doerschel, B. (Technische Univ., Dresden (German Democratic Republic)). Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

44032 (INIS-mf–11483, pp. 5) **Preliminary results in assessing of radiation exposure of the public in the GDR.** Przyborowski, S. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

44033 (INIS-mf–11483, pp. 16) **Radiation protection aspects in the use of potential sources of X-rays.** Anger, K. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Technische Univ., Dresden (German Democratic Republic). Sektion Physik. 1989. (CONF-8904255–: 21. international symposium radiation protection physics, Bad Schandau (German Democratic Republic), 3-7 Apr 1989). In *Abstracts of 21. International Symposium Radiation Protection Physics.* Order Number DE89633108/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Abstract only.

44034 (INIS-mf–11492) **Code of practice : safe use of ionizing radiation.** Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Occupational Health and Safety Unit. Jul 1988. 44p. Order Number DE89635274/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Ionizing radiation is used extensively in the field of scientific research. The risk of uncontrolled exposure to both the worker and the environment is ever present. The purpose of this Code is to set out practices considered by the CSIRO Health and Safety Committee to be appropriate for CSIRO staff and, if followed, they will result in appropriate protection for research staff and the environment. The Code does not cover sources of non-ionizing radiation such as microwave ovens, RF generators and laser sources.

44035 (INIS-mf–11503, pp. 116) **Measurement of radioactivity in the urine of radioisotope workers in hospitals - is it worthwhile ?.** Shimony, A. (Beilinson Hospital, Petah Tiqva (Israel).

Dept. of Nuclear Medicine); Kalish, Y. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Summary only.

44036 (INIS-SU–100, pp. 121-126) **Possibilities of the mathematical analysis of the complex spectral compositions.** Churakov, A.K. (Moskovskij Inzhenerno-Fizicheskij Inst., Moscow (USSR)); Slyusarenko, A.I.; Kovalenko, V.V.; Korobkina, E.I. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The method of restoring scintillation spectra for precise measurements of low rate exposure doses in a wide range of gamma-radiation energies, is described. The solution of the problem of separation of complex multiplets into separate spectral components (up to 30 in one multiplet) in the case of apriori information on their energy, is considered. The estimates of precision of problem solution depending on statistics, spectrometer resolution ability and the range of changes of component intensities in the spectrum are obtained. The effect of apriori information on the shape and parameters of the response function of equipment on the errors of component intensities is discussed. 5 refs.; 5 figs.

44037 (NCS-R–3, pp. 61-64) **Proceedings of the symposium on thermoluminescence dosimetry.** Pauw, H. (Philips Occupational Safety Department, Eindhoven (Netherlands)); Wittenbernds, C.J.H. Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on thermoluminescence dosimetry.* Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Includes index of authors.

The personnel dosimetry system and its results are described as part of the Philips health surveillance program for radiologic work. (H.W.). 2 tabs.

44038 (NCS-R–3, pp. 95-100) **Experience with in vivo thermoluminescent dosimetry for total body irradiation.** Van Dam, J. (Leuven University Hospital St. Raphael (Belgium). Department of Radiotherapy); Rijnders, A. Nederlandse Commissie voor Stralingsdosimetrie, Bilthoven (Netherlands). Oct 1988. (CONF-8803227–: Symposium on thermoluminescence dosimetry, Bilthoven (Netherlands), 30 Mar 1988). In *Proceedings of the symposium on thermoluminescence dosimetry.* Order Number DE89633653/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Includes index of authors.

In this contribution the possibilities of the thermoluminiscence dosimetry method under the difficult conditions of total body irradiation at low dose rate are illustrated. (H.W.). 2 res.; 1 fig.

44039 (RERF-TR–10-88) **Salivary gland doses from dental radiographic exposures.** Hoshi, Masaharu; Kato, Kazuo; Wada, Takuro; Antoku, Shigetoshi; Russell, W.J. Radiation Effects Research Foundation, Hiroshima (Japan). Jan 1989. 9p. (In Japanese, English). Order Number DE89906460/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Salivary gland doses incurred during dental radiography were measured by phantom dosimetry, and these dose data and data obtained during a two-week survey of Hiroshima and Nagasaki dental hospitals and clinics were used to estimate the respective doses to members of the populations of the two cities. The results obtained were used to supplement previously determined doses to the thyroid gland, lens, and pituitary gland from dental radiography. No significant differences in doses were observed by age, sex or city. Doses to the salivary glands during dental radiography are probably not sufficiently large to cause bias in assessments of atomic bomb survivors for late radiation effects. However, the steadily increasing use of dental radiography underscores the need for continued monitoring of dental radiography doses in the interests of these assessments. (author).

44040 **Beamline and irradiation chamber for dosimetry and biology studies using synchrotron radiation.** Meger, C. M. (Department of Medical Physics, University of Wisconsin-Madison, Madison, Wisconsin 53706 (US)); Pearson, D. W.; DeLuca, P. M., Jr.; Wells, G. M.; Cerrina, F.; Gould, M. N. *Review of Scientific Instruments (USA),* 60(7): 2235-2238 (Jul 1989).

Ultrasoft x rays are a useful probe for mechanistic studies of radiation damage in living cells. The highly localized energy deposition from a low energy x-ray occurs in a volume comparable to the sensitive biological targets within a cell, so that these low-energy x rays can be used as a tool to investigate radiation effects on the subcellular level. In the ultrasoft x-ray energy region the bright intensity and tunable energy selection of synchrotron radiation is unmatched by conventional sources. A beamline and irradiation chamber for dosimetry and radiation biology studies has been set up at the ES-0 exposure station of the Center for X-ray Lithography at Aladdin. The beamline includes a 10-μm-thick Be entrance window and a combination filter and single synthetically fabricated multilayer mirror for energy selection. The irradiation chamber contains another Mylar window for isolation, a two-dimensional scanning system allowing a 400-cm^2 exposure area with scanning rates up to 3.5 cm/s, a rotating feedthrough system that enables motion in the third dimension, several viewports and a specially designed cell sample holder which can be filled with gases at various pressures and holds up to 18 cell culture dishes. The system has been characterized with a gas flow proportional counter to determine energy bandpass and spectral purity and a calorimeter and ionization chamber to assess photon intensity at various energies within the range 500–2000 eV.

44041 **Data acquisition and beamline control software.** Brennan, S. (National Institute of Standards and Technology, Quantum Metrology Division, Gaithersburg, Maryland 20899 (US)); Cowan, P. L. *Review of Scientific Instruments (USA),* 60(7): 2253-2256 (Jul 1989).

A fortran program is described that runs on a 16-bit minicomputer under a single-user real-time operating system. This program combines interrupt-driven data collection, beamline positioning, and data analysis in a way that allows analysis of previously collected data while the program is collecting new data. It has been successfully used for several years on beamline X-24A at the National Synchrotron Light Source for fluorescence spectroscopy studies, surface extended x-ray absorption fine structure, and back-reflection standing-wave measurements.

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Refer also to citation(s) 42485, 42551, 42554, 42562, 42739, 42773, 43764, 43783, 43972, 43981

44042 (AD-A–206654/6/XAB) **Nuclear magnetic resonance and laser-scattering techniques at high pressure.** Jonas, J. Illinois Univ., Urbana, IL (USA). Dept. of Chemistry. 1987. 44p. Available from NTIS, PC A03/MF A01.

Pub. in High Pressure Chemistry and Biochemistry, 193-235(1987).

This review covers various aspects of nuclear magnetic resonance spectroscopy and laser Raman and Rayleigh spectroscopy at high pressure. The presentation is organized into the following main sections: 1. Introduction; 2. Experimental High Pressure NMR Techniques; 3. Experimental High-Pressure Laser Scattering Techniques; 4. Applications of NMR at High Pressure; 5. Applications of Laser Raman Scattering at High Pressure. The main emphasis is on studies aimed towards improving our fundamental understanding of the dynamic structure of fluids but several examples dealing with disordered solids are also included.

44043 (DOE/ER/45333–2) **Mixed-valent and heavy fermions and related systems: Second technical progress report, [May 1987–June 1988].** Schlottmann, P. Temple Univ., Philadelphia, PA (USA). Dept. of Physics. 14 Jul 1989. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER45333. Order Number

DE89016335/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Brief discussions are given in this progress report on the following topics: the 4f-quadrupolar moment of Yb in $YbCu_2Si_2$; thermodynamics of the n-channel Kondo problem in a magnetic field; the two-impurity Kondo problem; critical behavior of Heisenberg chains; spin-wave theory of the two-dimensional antiferromagnet with impurities; one-dimensional Hubbard model with attractive on-site U; the Gutzwiller dynamic susceptibility; and high-temperature superconductivity. (LSP)

44044 (DOE/ER/45376–1) **Dynamics of surface melting: Progress report, September 1, 1988–December 31, 1989.** Elsayed-Ali, H.E. Rochester Univ., NY (USA). Lab. for Laser Energetics. Jul 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER45376. Order Number DE89016337/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The objectives of this program is to study the phenomena of surface melting of single crystals of metals, to test for its existence, and to investigate its dynamics using picosecond reflection high-energy electron diffraction (RHEED). In this year, the UHV facility containing picosecond RHEED has become fully operational with a dedicated laser system and image acquisition capabilities. Details of this facility are described. This system was utilized to study surface heating and cooling of a PB(110) crystal subjected to picosecond laser irradiation. Diffraction pattern sensitivity to temperature is due to the surface Debye-Waller factor which results in a reduced number of elastically scattered electrons with lattice heating. Development of a picosecond time-resolved surface temperature probe is a key step to study the dynamics of surface melting that was well demonstrated in our present work. A heat diffusion model of surface heating and cooling has also been constructed. Results on static RHEED experiments on surface melting of Pb(110) crystal are presented. The existence of a surface melting (disordering) transformation at temperatures at least 50°K below the bulk melting point was observed in our experiments. Quantitative RHEED study of this phenomena are in progress.

44045 (INIS-SU–98, pp. 23) **Orientational dependence of incoherent scattering of ultrarelativistic electrons in silicon monocrystal.** Blazhevich, S.V.; Antipenko, A.P.; Bochek, G.L.; Maslov, N.I.; Shramenko, B.I. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

Short note; 2 refs.; 1 fig.

44046 (INIS-SU–98, pp. 24) **Parameters of ultrarelativistic electron scattering in silicon monocrystals of different thickness.** Blazhevich, S.V.; Bochek, G.L.; Maslov, N.I.; Shramenko, B.I. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

Short note; 2 refs.; 1 fig.

44047 (INIS-SU–98, pp. 25) **Angular distributions of ultrarelativistic electrons scatterd by Si monocrystals 10 μm thick.** Blazhevich, S.V.; Maslov, N.I.; Shramenko, B.I. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

Short note; 1 fig.

44048 (INIS-SU–98, pp. 26) **Angular dependence of electron multiple scattering in diamond monocrystals.** Avakyan, A.R.; Avakyan, R.O.; Avetisyan, A.Eh.; Asatryan, R.A.; Dallakyan, K.R.; Danagulyan, S.S.; Matevosyan, Eh.M.; Tarosyan, S.P. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

Short note; 2 refs.

44049 (INIS-SU–98, pp. 27) **Multiple scattering on potential discretenesses, electrons and phonons at establishing volume trapping.** Mazur, E.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

Short note; 2 refs.

44050 (INIS-SU–98, pp. 28) **Distribution of energy losses of fast charged particles in oriented monocrystals.** Kudryashov, N.A.; Petrovskij, S.V.; Strikhanov, M.N. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

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44051 (INIS-SU–98, pp. 29) **Continuous potential approximation in the quantum theory of fast particle scattering in crystals.** Kirillyuk, A.P.; Molodkin, V.B. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

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44052 (INIS-SU–98, pp. 30) **On the effect of edge dislocations on electron planar channeling.** Popov, D.E.; Pavlov, S.D.; Savukin, S.E. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

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44053 (INIS-SU–98, pp. 30-31) **Experimental angular distributions of 3.3 MeV electrons behind a silicon monocrystal.** Lazar', A.P.; Kamyshan, A.S. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

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44054 (INIS-SU–98, pp. 31) **Coexistence of itinerant and coordinate states of transverse motion of a quantum channeled**

particle. Mazur, E.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309--: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
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44055 (INIS-SU--98, pp. 32) **Study of field structure in ionic crystals in case of light particle planar channeling.** Gevorkyan, A.S.; Korkhmazyan, N.N.; Melikyan, G.G. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309--: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
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44056 (INIS-SU--98, pp. 33) **Characteristic radiation at negatively charged particle channeling.** Filimonov, Yu.M. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309--: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
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44057 (INIS-SU--98, pp. 34) **Fine structure of X-ray fluorescent angular spectrum of a crystal surface irradiated with fast electrons.** Gorodnichev, E.E.; Dudarev, S.L.; Rogozkin, D.B.; Ryazanov, M.I. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309--: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short note; 2 refs.

44058 (INIS-SU--98, pp. 35) **Anomalous orientational dependence of the cross section of crystal atom ionization by backscattered electrons.** Gomoyunov, M.V.; Dudarev, S.L.; Pronin, I.I. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309--: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short note; 1 fig.

44059 (INIS-SU--98, pp. 36) **Mean square angles of 1200 MeV electron multiple scattering in silicon monocrystals of various thickness.** Lapin, N.I.; Kasilov, V.I.; Shcherbak, S.F. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309--: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short note; 1 ref.; 1 fig.

44060 (INIS-SU--98, pp. 37) **Simulation of multiple scattering of relativistic particles in crystals.** Truten', V.I.; Shul'ga, N.F. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309--: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short note; 2 refs.

44061 (INIS-SU--98, pp. 38) **Specific features of channeling ion backscattering on dislocations in crystals with diamond lattice.** Komarov, F.F.; Shiryaev, S.Yu.; Safronov, N.V. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309--: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
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44062 (INIS-SU--98, pp. 39) **Peculiarities of various ions dechanneling in tungsten monocrystal.** Kazak, L.A.; Legotina, N.N.; Semyannikov, V.E.; Urmanov, A.R. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309--: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
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44063 (INIS-SU--98, pp. 40) **Proton stopping in boron nitrides of two modifications.** Kazak, L.A.; Neshov, F.G.; Khokhlova, E.M. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309--: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
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44064 (INIS-SU--98, pp. 41) **On antiproton channeling in silicon.** Balashova, L.L.; Grankina, T.V.; Kabanchik, N.M.; Pokhil, G.P. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309--: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
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44065 (INIS-SU--98, pp. 42) **Quasiclassical calculations of proton channeled energy losses.** Erokhin, K.M.; Kaiashnikov, N.P. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309--: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
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44066 (INIS-SU--98, pp. 43) **Description of proton stopping cross section near maximum in the local plasma frequency approximation.** Khodyrev, V.A.; Chumanov, V.Ya. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309--: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged*

particle interaction with crystals. Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short note; 3 refs.

44067 (INIS-SU–98, pp. 47) **Shadow and channeling effects for recoil nuclei in a silicon monocrystal.** Karamyan, S.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
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44068 (INIS-SU–98, pp. 48) **Anomalous dependence of damaging power on the atomic number ion in interactions with germanium monocrystal.** Karamyan, S.A.; Rykhlyuk, A.V.; Bugrov, V.N. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
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44069 (INIS-SU–98, pp. 49) **Orientational effects while fast neutron and γ-quanta passing through crystals.** Baryshevskij, V.G.; Zajtseva, A.M. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
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44070 (INIS-SU–98, pp. 50) **Double scattering of multicharged ions from thin self-supported films.** Bazhukov, S.I.; Puzanov, A.A.; Urmanov, A.R. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short note; 1ref.; 1 fig.

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44108 (INIS-SU–98, pp. 153) **Study of the sputtered substance spatial distributions under argon ion bombardment of a copper polycrystal in a wide range of incidence angles.** Dodonov, A.I.; Krylova, E.A.; Mashkova, E.S.; Molchanov, V.A.; Fayazov, I.M.; Fedorovich, S.D. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
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44109 (INIS-SU–98, pp. 155) **Energy and angular distributions of primary recoils atom knocked out of crystals under ion bombardment.** Borisov, A.M. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short note; 2 refs.

44110 (INIS-SU–98, pp. 156) **Isotopic effect in energy spectra of an ionized sputtered component.** Nikitenkov, N.N.; Kositsyn, L.G.; Markova, N.M.; Shulepov, I.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

44111 (INIS-SU–98, pp. 157) **Reflection coefficients of a light ion beam from layer-inhomogeneous targets.** Afanas'ev, V.P.; Manukhin, V.V.; Naueks, D. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short note; 2 refs.; 1 fig.

44112 (INIS-SU–98, pp. 158) **Study of heavy multicharged ion tracks in a metal surface.** Geguzin, Ya.E.; Monastyrenko, V.E.; Ter-Ovanes'yan, E.A. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

44113 (INIS-SU–98, pp. 161) **γ-quanta radiation effect on the dislocational structure of monocrystalline silicon.** Timoshnikov, Yu.A.; Lapsker, I.A.; Koroteev, Yu.M.; Filipenko, L.A.; Fotin, A.B. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

44114 (INIS-SU–98, pp. 165) **Study of laser-induced defect formation in InP and InAs by the channeling method.** Burdel', K.K.; Kashkarov, P.K.; Timoshenko, V.Yu.; Chechenin, N.G. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

44115 (INIS-SU–98, pp. 167) **Liquid-phase crystallization of laser-irradiated iron disilicide.** Kas'ko, I.V.; Gaertner, K.; Goetz, G. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

44116 (INIS-SU–98, pp. 169) **Formation of deep radiation centers in 300 keV proton-irradiated silicon.** Kuznetsov, N.V.; Kulikauskas, V.S.; Filatov, V.N. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

44117 (INIS-SU–98, pp. 170) **Simultaneous study of the profiles of several types of defects by the backscattering method.** Voronov, V.A.; Nechaev, Yu.I.; Pokhil, G.P. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

44118 (INIS-SU–98, pp. 170-171) **Set of programs for backscattering spectrum unfolding.** Zatekin, V.V. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short note; 3 refs.

44119 (INIS-SU–98, pp. 171) **Study of low-energy proton relative ranges in emulsions of various concentration.** Polandov, A.G.; Lipatov, G.N.; Gorbunov, S.M. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

44120 (INIS-SU–98, pp. 172) **Radiation damages in PbS epilayers under different types of irradiation.** Zajkina, R.F.; Drozd, I.A.; Sarsembinov, Sh.Sh. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, Moscow (USSR), 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

44121 (INIS-SU–98, pp. 116) **Kinetics of cooling a displacement cascade induced by a fast particle in solids.** Kashlev, Yu.A.; Shemaeva, I.N. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

44122 (INIS-SU–98, pp. 121) **Formation of Si_xN_y deep layers in silicon by 1.7 MeV nitrogen ion implantation.** Gorodishchenskij, A.L.; Kazak, L.A.; Neshov, F.G.; Pyatkova, T.M.; Semyannikov, V.E.; Urmanov, A.R. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

44123 (INIS-SU–98, pp. 126) **Calculation of two-dimensional implantation profiles in multilayer solid structures.** Ruvinskij, M.A.; Gol'denberg, A.B. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

44124 (INIS-SU–98, pp. 137) **Simulation of crystal structure disordering during ion implantation.** Abdrashitov, V.G.; Ryzhov, V.V.; Sannikova, S.V.; Turchanovskij, I.Yu. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

44125 (INIS-SU–98, pp. 146) **Study of strained superlattice of $In_xGa_{1-x}As/GaAs$ by the RBS, channeling and X-ray diffraction methods.** Lenkajt, K.; Flagmajer, R.; Kanter, Yu.O.; Fedorov, A.A.; Baumbakh, T.; Burdel', K.K.; Chechenin, N.G. AN SSSR, Moscow (USSR); Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. (In Russian). (CONF-8805309–: 18. All-Union conference on charged particle interaction with crystals, 30 May - 1 jun 1988). In *Summaries of reports of the 18. All-union conference on charged particle interaction with crystals.* Order Number DE89012189/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

44126 (INIS-SU–100, pp. 152-155) **Selection of the geometry of the Moessbauer experiment on scattering taking into account cosine spectra distortion.** Belozerskij, G.N.; Semenov, V.G.; Sokolov, A.Yu. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, Vilnyus (USSR), 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

It is reported that cosine distortion for the Moessbauer spectrum brings about line expansion, decrease in its amplitude and the shift of its position to higher velocities. These changes are the more pronounced the further is the line from velocity zero in the spectrum and the higher is its body angle value. The application of a source with the minimum possible spot diameter with the retention of its activity is suggested, and the collimation conditions are discussed. 3 refs.; 1 fig.

44127 (INIS-SU–102) **Experimental and theoretical physics. Collection.** Kratkie soobshcheniya po fizike. no. 9. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. V (In Russian). Available from NTIS (US Sales Only), PC A04/MF A01; INIS.
Kratkie soobshcheniya po fizike.; no. 9.

The effect of magnetic point defects, causing coercive force in high-quality ferrite-garnet films, on dynamics of an isolated domain wall (DW) is investigated. It is experimentally proved that DW interaction with defects results in effective reduction of DW mobility. 7 refs.; 3 figs.

44128 (INIS-SU–102, pp. 32-33) **Lanthanum and yttrium oxisulfide films grown from the vapor phase.** Maksimovskij, S.N.;

Sidorov, P.P. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89012199/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 9.

For the first time lanthanum and yttrium oxysulfide films are grown by light evaporation. The structure, photoluminescence, optical IR transmission of these films are investigated. Luminescent films of Y_2O_2S:Eu; La_2O_2S:Tb; La_2O_2S:Yb, Er are grown on sapphire, molten quartz, barium fluoride sbstrates. It is shown that the films are characterized by intensive photoluminescence, and emission lines of activator rare earth ions belong to, at least, two centre types. While studying IR transmission of La_2O_2S:Tb thin films absorption lines are observed in the 8-18μm range, which cannot be observed in three-dimensional monocrystals. 4 refs.

44129 (INP–1302/PS, pp. 300-319) **Level mixing resonances and some applications to nuclear physics and to solid state physics.** Scheveneels, G. (Louvain Univ. (Belgium). Inst. for Nuclear- and Radiationphysics); Hardeman, F.; Put, P.; Coussement, R. Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

The case of perfect alignment of the magnetic field in the direction of the z-axis of the EFG is considered. Isomeric state produced and aligned by nuclear reaction in a single crystal with hexagonal structure is analysed and experiments at the cyclotron (on isomeric states) of ^{71}Ge, ^{69}Ge are described. 11 refs., 13 figs. (L.I.).

44130 (KEK–88-9, pp. 109-115) **High energy magnetic excitations.** Endoh, Yasuo (Tohoku Univ., Sendai (Japan). Dept. of Physics). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8710488–: Workshop on neutron scattering research with intense spallation neutron source, 6-7 Oct 1987). In *Proceedings of the workshop on neutron scattering research with intense spallation neutron source 'today and tomorrow'. First meeting of Japan-UK collaboration in neutron scattering research.* Order Number DE89906380/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

The report emphasizes that the current development in condensed matter physics opens a research field fit to inelastic neutron scattering experiments in the eV range which is easilly accessed by spallation neutron sources. Several important subjects adopted at thermal reactors are shown. It is desired to extend the implementation of the spectroscopic experiments for investigation of higher energy magnetic excitations. For La_2CuO_4, which is the mother crystal of the first high Tc materials found by Bednortz and Muller, it seems to be believed that the magnetism is well characterized by the two-dimensional Heisenberg antiferromagnetic Hamiltonian, and it is widely accepted that the magnetism is a most probable progenitor of high Tc superconductors. The unusual properties of spin correlations in this crystal have been studied extensively by standard neutron scattering techniques with steady neutrons at BNL. FeSi is not ordered magnetically but shows a very unique feature of temperature induced magnetism, which also has been studied extensively by using the thermal neutron scattering technique at BNL. In these experiments, polarized neutrons are indispensable to extract the clean magnetic components out of other components of non-magnetic scattering. (N.K.).

44131 (KEK–88-9, pp. 116-122) **Dynamic structure factor S(Q, ω) in liquids.** Okada, Isao (Tokyo Inst. of Tech. (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8710488–: Workshop on neutron scattering research with intense spallation neutron source, 6-7 Oct 1987). In *Proceedings of the workshop on neutron scattering research with intense spallation neutron source 'today and tomorrow'. First meeting of Japan-UK collaboration in neutron scattering research.* Order Number DE89906380/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

The dynamic structure factor S(Q, ω) can be determined by inelastic neutron scattering of liquids. This quantity can be derived also from molecular dynamics (MD) simulation. Recently, the S(Q, ω) determination of some simple molten salts by neutron scattering has intensively been done by McGreevy's group at University of Oxford. The present report introduces their work and compare some of their results with those obtained from molecular dynamics (MD) simulation by Dixon. Results on the total dynamic structure factor for molten $Cs^{37}Cl$ and $Cs^{N}Cl$ at 973K, and quasi-dispersion curves for molten CsCl are shown and discussed. The total static structure factor $S_T(Q)$ derived from $S_T(Q, \omega)$ by integration with respect to ω agrees well with that obtained by diffraction. Dixon has carried out MD simulation for NaI. The experimental data by McGreevy et al. are compared with the data derived by the MD simulation. The general shape of the experimental curves, including the de Gennes narrowing, is predicted reasonably by the MD simulation. In conclusion, the single-particle motion is represented by $S_+^s(Q, \omega)$ and $S_-^s(Q, \omega)$. The longitudinal 'acoustic' type modes are represented by $C_{mm}{}^L(Q, \omega)$. The longitudinal 'optic' type modes are represented by $C_{qq}{}^L$. It is expected that many of the features of the Spallation Neutron Source at the Rutherford Appleton Laboratory will make it ideally suited for extending this kind of work. (N.K.).

44132 (LA-UR–89-2419) **High-temperature/high-pressure x-ray diffraction: Recent developments.** Schiferl, D.; Johnson, S.W.; Zinn, A.S. Los Alamos National Lab., NM (USA). [1989]. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890798–6: AIRAPT and EHPRG international high pressure science and technology conference, 17-21 Jul 1989). Order Number DE89015255/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have developed two Merrill-Bassett diamond-anvil cells for specialized high-temperature uses. The first is constructed largely of rhenium to provide uniform, constant P and T on the order of 20 GPa at 1200 K for extended periods. The second is for single-crystal x-ray diffraction, but can be heated to 630 K at 20 GPa to grow single-crystal samples which cannot be produced at room temperature. With this cell, the crystal structure of ε-O_2 was shown to be monoclinic with a = 3.649 A, b = 5.493 A, c = 7.701 A, and B = 116.11° at 19.7 GPa. 15 refs.

44133 (ORNL/FTR–3341) **[Sir Roger Elliott 60th birthday symposium, Oxford, England, United Kingdom Atomic Energy Agency, Harwell, and Rutherford Appleton Laboratory, Didcot, July 10–14, 1989]: Foreign trip report.** Cooke, J.F. Oak Ridge National Lab., TN (USA). 31 Jul 1989. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89016394/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The author attended the Sir Roger Elliott 60th Birthday Symposium held at the Clarendon Laboratory, Oxford, England. After this three-day symposium the author spent two days at the Rutherford Appleton Laboratory and presented a seminar on excitations in magnetic systems. This visit was intended to provide continuity to a long-standing and productive collaboration with members of the scientific staff. During a visit to Harwell, the author participated in discussions about Harwell's theoretical physics program and their work on cold fusion.

44134 (RAL–89-031) **Permanent recording of transient lattice perturbations.** Russell, F.M. Rutherford Appleton Lab., Chilton (UK). Apr 1989. 15p. Order Number DE89634306/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A new solid-state recording mechanism has been identified which is capable of recording the tracks of charged light leptons and the tracks of uncharged supra-ballistic phonons. The dynamic range for recording charged leptons exceeds 50:1 with a minimum sensitivity of dE/dx $\simeq$ 0.01 MeV/cm. For supra-ballistic phonons their energy must exceed $\simeq$ 10eV to be recorded. The recording mechanism depends upon the presence in a crystal of muscovite of a low concentration of mobile impurity atoms which are normally energetically unable to accrete. The passage of a charged particle or of an energetic ballistic phonon locally modifies the crystal internal potentials to allow the impurity atoms to accrete, driven by their thermal energy, to form stable nucleation sites. Further accretion of the impurity at the nucleation sites causes massive decoration giving a lateral magnification of upto 10^5 and so rendering the tracks visible to the unaided eye. (Author).

44135 (SSI–89-01) **The neutrino - an indirectly ionizing radiation.** Persson, L. National Inst. of Radiation Protection, Stockholm (Sweden). 13 Jan 1989. 8p. Order Number DE89796488/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

In this note a description of the neutrino interaction with matter is given indicating that the neutrino is an indirectly ionizing radiation. (orig.).

44136 (UCRL–99314) **Analysis of DC magnetron sputtered beryllium films.** Price, C.W.; Hsieh, E.J.; Lindsey, E.F.; Pierce, E.L.; Norberg, J.C. Lawrence Livermore National Lab., CA (USA). Oct 1988. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8810401–1: High power laser optical components topical meeting, 24-25 Oct 1988). Order Number DE89015727/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We are evaluating techniques that alter the columnar grain structure in sputtered beryllium films on fused silica substrates. The films are formed by DC magnetron sputtering, and the columnar structure, which is characteristic of this and most other deposition techniques, is highly detrimental to the tensile strength of the films. Attempts to modify the columnar structure by using RF-biased sputtering combined with nitrogen pulsing have been successful, and this paper describes the analyses of these films. Sputtered beryllium films are quite brittle, and the columnar structure in particular tends to form a distinct intergranular fracture; therefore, the grain structure was analyzed in fractured specimens using the high-resolution capability of a scanning electron microscope (SEM) equipped with a field emission gun (FESEM). Ion microanalysis using secondary-ion mass spectroscopy (SIMS) was conducted on some specimens to determining relative contamination levels introduced by nitrogen pulsing. The capability to perform quantitative SIMS analyses using ion-implanted specimens as standards also is being developed. This work confirms that the structure of DC magnetron sputtered beryllium can be improved significantly with combined nitrogen pulsing and RF-biased sputtering. 8 refs.

44137 Diffraction effects along the normal to a grain boundary. Vitek, J.M. (9501970); Vaudin, M.D.; Ruhle, M.; Sass, S.L. *Scripta Metallurgica (USA)*, 23(3): 349-354 (Mar 1989).

Much work has been done in recent years on studying the structure and properties of grain boundaries and interfaces in general. Included in these studies is work done by the authors on diffraction effects from grain boundaries along the reciprocal lattice direction which passes through the origin and is normal to a planar boundary. These studies considered the simplified case of kinematical diffraction effects caused by distortions normal to the planar interface in the boundary region and are distinct from extensive electron and X-ray diffraction studies of extra reflections resulting from periodicities in the plane of a grain boundary. Discrepancies exist in the results of these different studies. Differences were found between the calculated intensity distributions. These differences were attributed to the calculation procedures. Second, the effect of crystal shape on the diffraction calculations was disputed. Finally, the application of the results to experimental work and the interpretation of experimental results were matters of controversy. The intent of the present paper is to clarify and resolve these differences, including some issues that have not been raised previously in the literature.

44138 Low-energy He^+ scattering from deuterium adsorbed on Pd(110). Bastasz, R. (Sandia National Laboratories, Livermore, California 94551 (US)); Felter, T. E.; Ellis, W. P. *Physical Review Letters (USA)*, 63(5): 558-561 (31 Jul 1989). DOE Contract AC04-76DP00789.

We show that low-energy, helium ion scattering in the forward direction provides a surface specific means for directly observing adsorbed deuterium. Energy spectra of 1-keV $^4He^+$ scattered at angles less than 30° from a surface with adsorbed D contain the two maxima predicted for classical single scattering. Angular studies indicate that D atoms adsorbed on the Pd(110) surface at room temperature reside in the troughs between atom rows.

44139 Ion dose dependence of the sputtering yield of Ru(0001) at very low fluences. Burnett, J. W. (Materials Science and Chemistry Divisions, Argonne National Laboratory, Argonne, Illinois 60439 (US)); Pellin, M. J.; Calaway, W. F.; Gruen, D. M.; Yates, J. T., Jr. *Physical Review Letters (USA)*, 63(5): 562-565 (31 Jul 1989). DOE Contract W-31-109-ENG-38.

The neutral sputtered flux from a Ru single crystal oriented along the (0001) axis has been determined as a function of primary ion dose in real time using nonresonant photoionization techniques coupled with time-of-flight mass spectrometry. The data reveal, surprisingly, that the sputtering yield is twice as large from an undamaged surface as that from a slightly damaged surface. The sputtering yield decreases until steady state is reached at a primary ion fluence of only 2×10^{15} ions cm^{-2}. Data analysis results in an estimated cross section for damage of $(2.7\pm1.0)\times10^{-15}$ cm^2.

44140 Growth dynamics of sputter deposition. Bales, G. S. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332 (US)); Zangwill, A. *Physical Review Letters (USA)*, 63(6): 692-692 (7 Aug 1989).

A Comment on the Letter by R. P. U. Karunasiri, R. Bruinsma, and J. Rudnick, Phys. Rev. Lett. 62, 788 (1989).

44141 Finite-temperature defect properties from free-energy minimization. LeSar, R. (Department of Materials Science and Engineering, University of Michigan, Ann Arbor, Michigan 48109 (US)); Najafabadi, R.; Srolovitz, D. J. *Physical Review Letters (USA)*, 63(6): 624-627 (7 Aug 1989).

We present two simple, but accurate, techniques for calculating the finite-temperature atomic structure and free energy of any solid defect (point or extended). The finite-temperature equilibrium atomic structure and thermodynamic properties of defects in solids are obtained *self-consistently* by minimizing the *reenergy* of the solid with respect to the coordinates of the atoms. Application of the two methods to a perfect crystal and one with a vacancy show that both methods yield excellent agreement with Monte Carlo calculations for temperatures up to at least 75% of the melting point.

44142 Theory of the acoustical properties of symmetric multilayer structures. Martin, B. G. (Analysis Consultants, El Toro, California 92630 (US)). *Journal of Applied Physics (USA)*, 66(5): 1931-1934 (1 Sep 1989).

A theoretical investigation has been made of the acoustical properties of symmetrical multilayer structures. Acoustic symmetric multilayers (ASMs) exhibit behavior analogous to that of optical symmetric multilayers. For a three-layer ASM, a range of effective acoustic impedances is possible merely by varying the thickness of the middle layer for a given frequency. This has the advantage that one can design an antireflection coating for virtually any substrate impedance. Some illustrative examples are given.

44143 Spectroscopy of positronium emission from alkali halides. Tuomisaari, M. (Lawrence Livermore National Laboratory, Livermore, California 94550 (US)); Howell, R. H.; McMullen, T. *Physical Review [Section] B: Condensed Matter (USA)*, 40(4): 2060-2069 (1 Aug 1989). DOE Contract W-7405-ENG-48.

Energy and angular distributions of the positronium emitted from single-crystal samples of the alkali halides LiF, NaF, KCl, KBr, and KI following bombardment of the surfaces with 0.1–4-keV positrons are reported. Energetically narrow positronium distributions were formed at the positron implant depth, and this hot positronium diffused to the surface, losing energy in the process. An analysis of the data using a diffusion model yields an estimate of the strength of the positronium-phonon coupling. This coupling is found to be energy dependent, with the effective deformation potential decreasing as the positronium energy increases. Positronium work functions and binding-energy estimates are also given. The angular distributions of the emitted positronium from all samples except LiF were sharply peaked in the forward direction. The energy distributions from the LiF samples also differed from those of the other alkali halides by showing two distinct energy components instead of a single peak.

44144 Self-consistent phonon approach to thermal vibrations in model small clusters. Shimamura, S. (Department of Physics, Virginia Commonwealth University, P.O. Box 2000, Richmond, Virginia 23284-2000 (US)); Khanna, S. N.; Jena, P. *Physical Review [Section] B: Condensed Matter (USA)*, 40(4): 2459-2463 (1 Aug 1989).

Thermal atomic vibrations in small clusters have been studied theoretically using the self-consistent phonon method. We have calculated the free energy for model clusters in which constituent atoms interact with each other through a pairwise potential and are vibrating with a frequency ω_n for the nth atom. Thermal softening and thermal expansion are investigated as a function of temperature for different structures of cluster sizes, N=7, 9, and 13. A structure with pentagonal caps is shown to be more stable vibrationally than a section of cubic structure of the same size. The instability temperature in the present model clusters is discussed in the context of melting in small clusters.

44145 Trapping model for thermal and nonthermal positrons in metals. Gramsch, E. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973-6000 (US)); Lynn, K. G. *Physical Review [Section] B: Condensed Matter (USA),* 40(4): 2537-2540 (1 Aug 1989). DOE Contract AC02-76CH00016.

In order to correct the discrepancies of the simple two-state trapping model currently being used to explain the temperature dependence of positron annihilatoin in metals, we have modified the standard trapping model to implicitly include nonthermal trapping of positrons in vacancies and divacancies. A positron-energy-loss function and energy-dependent trapping rates were used to calculate the mean lifetime and intensity of the trapped and untrapped positrons. We have fitted this model to the lifetimes for aluminum measured by Jackman *et al.* Results obtained for the formation enthalphy of vacancies and divacancies show the feasibility of the model to fit the experimental data.

44146 Mean-field theory for the *t-J* model. Jayaprakash, C. (Department of Physics, The Ohio State University, Columbus, Ohio 43210 (US)); Krishnamurthy, H. R.; Sarker, S. *Physical Review [Section] B: Condensed Matter (USA),* 40(4): 2610-2613 (1 Aug 1989).

We present a new mean-field theory for the *t-J* model using a representation in which singly occupied sites or spins are represented by bosons and empty sites or holes by fermions. We obtain a phase diagram which includes ferromagnetic, antiferromagnetic, spiral (with the pitch inversely proportional to the density of holes), and disordered spin-liquid phases, with a clear separation of charge and spin excitations. We comment on the conditions for obtaining superconductivity in the model.

44147 Spin-1 *XXZ* model on the square lattice. Lin, H. Q. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973 (US)); Emery, V. J. *Physical Review [Section] B: Condensed Matter (USA),* 40(4): 2730-2732 (1 Aug 1989). DOE Contract AC02-76CH00016.

We compute the ground-state energy and spin-spin correlations on various finite square lattices exactly for the spin-1 *XXZ* model. Estimates of the ground-state energy and order parameters are obtained by extrapolation to infinite lattice. Our results are consistent with the existence of long-range order for all values of anisotropy Δ.

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Refer also to citation(s) 42500, 42501, 42510, 42511, 42512, 42517, 42518, 42519, 42550, 42551, 42552, 42558, 42564, 42565, 42566, 42567, 42568, 42569, 42570, 42571, 42622, 42927, 44012, 44043

44148 (AD-A-206481/4/XAB) **Reexamination of magnetic effects in the Bose gas.** Arias, T.A.; Joannopoulos, J.D. Massachusetts Inst. of Tech., Cambridge, MA (USA). Research Lab. of Electronics. 1 Mar 1989. 10p. Available from NTIS, PC A02/MF A01.

Pub. in Physical Review B, Vol. 39, No. 7, 4071-4078(1 Mar 1989).

The breakdown of the Meissner-Ochsenfeld effect in the three-dimensional Bose gas as the applied field passes through its critical value is an entropy-driven weakly first-order transition, rather than the second-order transition usually ascribed to the system. The transition is second order at the usual Bose condensation temperature Tc as well as T=O, with a line of first-order transitions connecting these critical points. The first-order transitions make the Bose gas resemble familiar superconductors, and a Landau-Ginzburg analysis indicates that the Bose gas is always a type-I superconductor.

44149 (BNL–43033) **Magnetic correlations in high T_c oxides: Neutron scattering studies.** Shirane, G. Brookhaven National Lab., Upton, NY (USA). [1989]. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE89016420/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A review is given of current neutron scattering experiments on $La_{2-x}Sr_xCuO_4$ and $Nd_{2-x}Ce_xCuO_4$. Incommensurate magnetic excitations are observed in a high quality single crystal of $La_{1.85}Sr_{0.15}CuO_4$, which exhibits a sharp superconducting transition at 33 K. The study of magnetic correlations in the electron-superconductor $Nd_{2-x}Ce_xCuO_4$ is now being carried out. 18 refs., 7 figs.

44150 (BNL–43034) **Magnetic correlations in high T_c oxides in the superconducting state.** Shirane, G. Brookhaven National Lab., Upton, NY (USA). 21 May 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE89016421/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A review is given of recent neutron scattering measurements on $La_{2-x}Sr_xCuO_4$ and Y $Ba_2Cu_3O_{6+x}$ single crystals. Well defined, modulated magnetic excitations are observed in a high quality single crystal of $La_{1.85}Sr_{0.15}CuO_4$. This crystal exhibits a sharp superconducting transition at 33 K with a high Meissner effect. For magnetic excitation energies of 9 MeV and lower, the intensity drops substantially below 150K. Similar magnetic scattering of $YBa_2Cu_3O_{6+x}$ in the superconducting region is now being sought. 10 refs., 2 figs.

44151 (BNL–43065) **Critical magnetic fields (H_{c2}, H_{c1}) and κ in $YBa_2(Cu_{0.98}M_{0.02})_3O_{7+\delta}$, M=Ni, Al, and Cu.** Xu, Youwen; Suenaga, M.; Moodenbaugh, A.R. Brookhaven National Lab., Upton, NY (USA). [1989]. 2p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890718–22: International conference on materials and mechanisms of superconductivity - high-temperature superconductors, Stanford, CA (USA), 23-28 Jul 1989). Order Number DE89016412/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The upper critical magnetic field H_{c2} up to 5T and $dM(T)/dH|_{H_{c2}}$ for aligned powders of pure and Al and Ni substituted $YBa_2(Cu_{.98}M_{.02})_3O_{7+\delta}$ are measured magnetically. $dH_{c2}/dT|_{Tc}$ is linear with slopes of −2.2T/K, −2.4T/K and −2.8T/K for the pure, Ni and Al samples respectively. The values of H_{c1}, κ, and $\Delta C/T_c$ were deduced from $dM(T)/dH|_{H_{c2}}$. 4 refs., 2 figs., 1 tab.

44152 (BNL–43072) **Theoretical studies of structural properties of the high-T_c superconductor $Y_1Ba_2Cu_3O_{7-x}$.** Valkealahti, S.; Welch, D.O. Brookhaven National Lab., Upton, NY (USA). [1989]. 2p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890718–23: International conference on materials and mechanisms of superconductivity - high-temperature superconductors, Stanford, CA (USA), 23-28 Jul 1989). Order Number DE89016411/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Structural properties of the high temperature oxide superconductor $Y_1Ba_2Cu_3O_{7-x}$ have been studied by static lattice simulation methods. Empirical (ionic) potentials, derived on the basis of experimental data, are used to describe the basic structural properties of the superconducting oxides. Several potential models, with different location of the extra charge for the O_7 compound, have been tested with respect to experimental lattice parameters. Fair parameterizations have been found in almost all cases, but they are usually valid only for a specific oxygen content. However, potential models, consistent both for O_6 and O_7, have been found. We present the best of our ionic models, where, in O_7, two thirds of the holes are distributed in the sheet-site oxygens and one third in oxygens between the sheet and chain planes. 12 refs.

44153 (INIS-SU–103/A, pp. 43-45) **Anisotropy of an upper critical field of superconducting monocrystalline $YBa_2Cu_3O_x$ and $HoBa_2Cu_3O_x$ films.** Golovashkin, A.I.; Krasnosvobodtsev, S.I.; Pechen', E.V.; Shabanova, N.P. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Quantum radiophysics. Collection.* Order Number DE89012203/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 12.

The temperature dependences $H_{C2}(T)$ of $MBa_2Cu_3O_x$(M=Y,Ho) superconducting films are measured. For monocrystalline films with $dH_{C2}/dT \sim 8T/K$ at perpendicular and with 1.4T/K at parallel to c-vector axis magnetic field orientations the coherence lengths are $\xi_c(0) \sim 3A$ and $\xi_{ab} \sim 16A$, $H_{C2}(0) \sim 520$ and 95T respectively. 4 refs.; 2 figs.; 1 tab.

44154 (INIS-SU–109/A, pp. 3-5) **Properties of third group impurity states in A_4B_6 superconductors.** Vinogradov, V.S. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics.* Order Number DE89012198/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 10.

A new model of the state of third group impurities in A_4B_6 superconductors is suggested. The model is based on results of the study, where the potential of impurity caused perturbation $v_d(r)$ is approximated by the sum of seven functions, located symmetrically in points, where the product of $V_d(r)$ and density of valent electrons in the crystal is maximal. $V_d(r)$ potential splits two states of s-symmetry from zones: σ-from zone of Pb,S (symmetrical combination of six p-functions Te)-from valent zones. the suggested model explains the difference in In and Te behaviour in PbTe. Superconductivity in PbTe(Tl) is discussed. 11 refs.; 2 figs.

44155 (INIS-SU–109/A, pp. 6-8) **Local pair concentration fluctuations and superconductivity in high-temperature superconducting oxides.** Golovashkin, A.I.; Ivanenko, O.M.; Mitsen, K.V. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics.* Order Number DE89012198/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 10.

Qualitative explanation of anomalous behaviour of same characteristics of high-temperature superconductors near T_c is suggested on the basis of assumption about carrier pairing from a wide band through their interaction with the system of local pairs. The mentioned anomalies can appear due to strong fluctuations of local pair concentration in such two-band system. Experimental results, obtained for $YBa_2Cu_3O_7$ are in qualitaive agreement with the suggested model. 23 refs.; 2 figs.

44156 (JINR-N–4(30)-88, pp. 8-13) **Investigation of high temperature superconductors at the Joint Institute for Nuclear Research.** Aksenov, V.L. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. In *JINR rapid communications. Collection of papers.* Order Number DE89012196/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; INIS.

This is a brief review of the performed at the JINR investigations in the field of high-temperature superconductivity physics and experimental methods exploited. 11 refs.

44157 (JINR-N–4(30)-88, pp. 38-48) **Diffraction study of some High-T_c superconductors with the time-of-flight neutron diffractometer DN-2.** Balagurov, A.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics); Hvan Chan Gen; Mironova, G.M.; Nguyen Van Vuong; Trinh Anh Kuan; Kudryashev, V.A.; Trunov, V.A.; Pajaczkowska, A.; Shimchak, H. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. In *JINR rapid communications. Collection of papers.* Order Number DE89012196/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; INIS.

The results of neutron diffraction experiments performed on high-T_c superconductors of the 1-2-3 type by using the time-of-flight diffractometer are discussed. The final profile R-factor is 2,7%. Ncutron diffraction on $YBa_2Cu_3O_7$ and $GdBa_2Cu_3O_7$ single crystals has been measured with the aim to reveal possible long-period modulation of the atomic structure. The incommensurate peaks are also absent, the lowest limit for the period of modulation is as high as 400A. The structure of $YBa_2(Cu_{1-x}Fe_x)_3O_{7-\sigma}$ has been determined at x=0,006 and 0,10. Some indications of occupying (2q) positions in the centre of octahedra with Fe atoms have been received. The (1a) positions on Cu-O chains contain both Fe-atoms and vacancies. 13 refs.; 4 figs.; 4 tabs.

44158 (JINR-N–4(30)-88, pp. 49-54) **Neutron scattering study of $YBa_2Cu_3O_{6+\sigma}$ ($0<\sigma<0,8$) oxides.** Balagurov, A.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics); Mironova, G.M.; Zalishchanskij, M.E.; Graboj, I.E.; Kaul', A.R.; Moshchalkov, V.V.; Muttik, I.G.; Shapiro, Ya.A. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. In *JINR rapid communications. Collection of papers.* Order Number DE89012196/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; INIS.

Neutron scattering study of $YBa_2Cu_3O_{6+\sigma}(\sigma)$=0-0,8 compounds is performed. For σ=0,08 we observed tetragonal crystal structure with lattice parameters a=3,840 A and c=11.737 A and an additional diffractional peak which may be considered as (1/2 1/2 1) magnetic reflection. Any other magnetic reflections corresponding to AF Structure suggested earlier have not been found within the limits of the experimental resolution and intensity. 7 refs.; 3 figs.; 1 tab.

44159 (JINR-N–4(30)-88, pp. 55-62) **On determination of the magnetic field penetration depth in oxide superconductors by polarized neutrons reflection.** Korneev, D.A.; Chernenko, L.P. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. In *JINR rapid communications. Collection of papers.* Order Number DE89012196/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; INIS.

The $R_+(k_{perpendicular})$ reflection coefficients are calculated for $YBa_2Cu_3O_7$ film sprayed on $SrTiO_3$ ($k_{perpendicular}$) is a normal to the surface component, of a wavevector of neutrons using the quatum mechanical model describing the reflection of neutrons from the surface of a thin superconducting film. The dependence of $S(k_{perpendicular})R_+(k_{perpendicular})/R_-(k_{perpendicular})$ on the depth of magnetic field penetration into a superconductor Λ on the external magnetic field H, and on a film thickness d is analysed. The possibility is motivated of carrying out experiments on determination of Λ under conditioncompared favourably with those under which the experiments with ceramic samples of high temperature superconductor have been conducted. 7 refs.; 4 figs.; 1 tab.

44160 (JINR-N–4(30)-88, pp. 63-66) **μSR-investigation of the high-T_c superconductor $HoBa_2Cu_3O_7$.** Duginov, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems); Grebinnik, V.G.; Graboj, I.E. and others. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. In *JINR rapid communications. Collection of papers.* Order Number DE89012196/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; INIS.

A high-T_c superconductor $HoBa_2Cu_3O_{7-\sigma}$ ($T_c \sim 93$ K) has been investigated by the μSR-method in a zero external magnetic field, the sample being cooled from the temperature much higher than T_c to T=4,2 K. The fast increasing of the muon spin depolarization in the temperature range 10-4,2 K is observed, which indicates the fluctuating production of the magnetic ordering in this sample. 3 refs.; 3 figs.

44161 (JINR-N–4(30)-88, pp. 67-72) **Positron annihilation in a high-temperature superconductor $YBa_2Cu_3O_{7-\sigma}$.** Wawryszczuk, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems); Lewandowski, M.; Rybakov, V.N.; Yutlandov, I.A.; Goworek, T.; Mazurek, P.; Uchevatkin, I.F. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. In *JINR rapid communications. Collection of papers.* Order Number DE89012196/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; INIS.

Positron annihilation as a function of temperature in high-temperature superconductors $YBa_2Cu_3O_{7-\sigma}$ has been investigated. It is shown that a change in the annihilation character at the transition into superconducting state is relatively small. The change of tau_1 and tau_2 positron lifetimes as well as of the intensity of the component with tau ~J_2 and Doppler broadening S parameter allows one to assume that transition into superconducting state is accompanied with a certain decrease in electron density and with decreasing number of defects or increasing their size. 9 refs.; 1 fig.

44162 (JINR-N–4(30)-88, pp. 73-77) **Effect of high energy radiation on critical parameters of superconducting ceramics $YBa_2Cu_3O_7$.** Aleksandrov, A.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy); Astapov, A.A.; Drobin, V.M. and others. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. In *JINR rapid communications. Collection of papers.* Order Number DE89012196/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; INIS.

Critical temperature (T_c) and critical current density (j_c) of high temperature superconducting (HTSC) ceramics $YBa_2Cu_3O_7$ were measured as functions of dose from $5x10^3$ Gy to $3x10^8$ Gy. Samples were irradiated at room temperature by protons with energies 0,66 and 8,09 GeV and by ^{12}C with energy 3,65 GeV/nucleon. Radiation degradation of critical parameters j_c and is obviously connected with the formation of disordered regions, leading to the electron localization and to the infractions of Josephson contacts between ceramics grains. 8 refs.; 2 figs.; 1 tab.

44163 (LA-UR–89-2469) **Superconductivity from valence fluctuations with finite u.** Brandow, B.H. Los Alamos National Lab., NM (USA). 1989. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890718–17: International conference on materials and mechanisms of superconductivity - high-temperature superconductors, 23-28 Jul 1989). Order Number DE89015302/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The finite-U paring mechanism of Newns is found to be opposed by a magnetic tendency arising from Gutzwiller renormalization of the hybridization. This competition restricts superconductivity and also reproduces the parabolic rise and fall of T_c in $La_{2-x}Sr_xCuO_4$ with increasing x. 9 refs.

44164 (LA-UR–89-2587) **High-energy helium backscattering for the compositional analysis of thin-film oxide-superconductors.** Hubbard, K.M.; Martin, J.A.; Muenchausen, R.E.; Tesmer, J.R.; Nastasi, M. Los Alamos National Lab., NM (USA). [1989]. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8906186–2: Materials Research Society materials analysis workshop, 14-17 Jun 1989). Order Number DE89015277/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Recent experiments have demonstrated that the broad elastic-scattering resonance for 8.8 MeV helium bombardment of oxygen can be exploited to measure the oxygen content of YBaCuO thin films. A potential difficulty with such measurements is distortion of the backscattering spectrum due to resonant scattering from the substrate elements, which could prevent the accurate integration of peak areas. We have measured the elastic scattering cross sections for Sr and Ti, relative to Gd, with He ions in the energy range of 2.2–8.8 MeV, and a scattering angle of 166°. The results verify that resonant scattering from the substrate does not interfere with the high-energy compositional analysis of YBaCuO films deposited on $SrTiO_3$. Scattering cross sections for Ca, measured relative to Ba, have also been determined for application to the analysis of BiSrCaCuO and TlCaBaCuO films. Because of resonant scattering from Ca at beam energies above 6 MeV, two backscattering measurements are required for these materials: one at 8.8 MeV to determine the O content, and one at or below 6 MeV to determine the Ca content. Anticipating a more general applicability of this technique to the analysis of metal-oxide films, data are also presented for a number of elements, as an empirical guideline, which give the beam energies above which scattering cross sections deviate from their Rutherford values, and must be determined experimentally. 10 refs., 6 figs., 4 tabs.

44165 (LBL–27402) **Specific heat of the high-T_c superconductor $(Bi_{1.66}Pb_{0.34})Ca_2Sr_2Cu_3O_{10}$.** Fisher, R.A.; Kim, S.; Wu, Y.; Phillips, N.E.; Ledbetter, H.M.; Togano, K. Lawrence Berkeley Lab., CA (USA). Jun 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890718–16: International conference on materials and mechanisms of superconductivity - high-temperature superconductors, Stanford, CA (USA), 23-28 Jul 1989). Order Number DE89015343/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The specific heat (C) was measured for H = 0 and 7T in the ranges 0.4 to 20K and 65 to 125K. The coefficient of the low-temperature linear term in C was 0 ± 0.5 mJ/K^2-mole. On initial cooling, an anomaly in C was observed at T_c, but there were dramatic temperature hysteresis effects. 5 refs., 4 figs.

44166 (UCRL–100539) **Calculation of the nuclear quadrupole resonance spectra of $YBa_2Cu_3O_{7-x}$.** Winter, N.W.; Violet, C.E. Lawrence Livermore National Lab., CA (USA). Jun 1989. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-890718–20: International conference on materials and mechanisms of superconductivity - high-temperature superconductors, Stanford, CA (USA), 23-28 Jul 1989). Order Number DE89016646/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Nuclear quadrupole resonance (NQR) and nuclear magnetic resonance (NMR) studies on $^{63,65}Cu$ have demonstrated the the resonance properties of these nuclei can give important information about the electronic structure of the high temperature superconductor $YBa_2Cu_3O_{7-x}$ as well as the exchange coupling energy between the Cu(2) sites. Measurements for various oxygen stoichiometries have given insight into the effect of oxygen content on the valence state of the Cu. In the work reported here, the electric field gradient (EFG) tensors at the Cu(1) and Cu(2) sites in $YBa_2Cu_3O_{7-x}$, have been determined from calculations on large clusters for x = 0 and 1. 13 refs., 2 tabs.

44167 (UCRL–101311) **Criterion for the superfluid/superconducting phase transition in two dimensions.** Peters, D.S.; Alder, B.J. Lawrence Livermore National Lab., CA (USA). Jun 1989. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890718–21: International conference on materials and mechanisms of superconductivity - high-temperature superconductors, Stanford, CA (USA), 23-28 Jul 1989). Order Number DE89016642/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

It has been found that He^4 films undergo a superfluid transition when the degeneracy parameter $\lambda^*/a \simeq 1$. This criterion also holds for the high temperature superconductors and, numerically, for Bose-Coulomb systems in two dimensions. 5 refs., 1 fig., 1 tab.

44168 Static Coulomb model for high-temperature superconductivity. Mahan, G. D. (Department of Physics and Astronomy, University of Tennessee, Knoxville, Tennessee 37996-1200 (US)). *Physical Review [Section] B: Condensed Matter (USA),* 40(4): 2200-2204 (1 Aug 1989). DOE Contract AC05-84OR21400.

Superconductivity in copper oxide planes is calculated using the static Coulomb model. This model is based upon the attractive nature of the Fourier transform of the Coulomb interaction for wave vectors near $a\mathbf{Q}=\pi(\pm1,\pm1)$. Values of λ and $\Delta(\mathbf{k})$ are calculated at $T=0$ and also at T_c where the gap equation becomes a linear matrix equation. For some regions of parameter space values of λ are near unity. The gap $\Delta(\mathbf{k})$ is anisotropic.

44169 Charge distributions and valency in copper oxide crystals related to superconductivity. Goodman, G. L. (Argonne National Laboratory, Argonne, Illinois 60439 (US)); Ellis, D. E.; Alp, E. E.; Soderholm, L. *Journal of Chemical Physics (USA),* 91(5): 2983-2992 (1 Sep 1989). DOE Contract W-31-109-ENG-38.

We present an overview of the discrete variational method for calculating orbital states of a molecular cluster in the local density approximation. Then we introduce a new method of embedding a finite molecular cluster in a crystal lattice. This new technique of cluster weighting is based on the bulk stoichiometry of the crystal and the Mulliken populations for chemically complete atoms—those atoms that have all their covalently bonded nearest neighboring atoms also in the cluster. We have applied our new approach to calculate linear-combination-of-atomic-orbitals ground states for seven copper oxide crystals and Cu metal. The average net Mulliken charges calculated for Cu atoms in this way are shown to correlate well with the observed energies of the Cu *K* edge feature in x-ray absorption spectra of these materials. Several of these compounds are important to understanding the high T_c superconductivity of copper oxides.

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Refer also to citation(s) 43257, 43870, 43871, 43991, 44097, 44394, 44406

44170 (AD-A–205837/8/XAB) **Nonlinear systems of conservation laws. Final report, July 1987-September 1988.** Shearer, M. North Carolina Univ., Chapel Hill, NC (USA). Dept. of Mathematics. 21 Nov 1988. 6p. Available from NTIS, PC A02/MF A01.

This final report covers research in the following three areas: (1) Non-strictly hyperbolic conservation laws: Change of type of equations modeling three-phase flow in porous media, solution of Riemann problems; (2) Plastic flow in two dimensions: Linear stability of homogeneous deformations, justification of the quasidynamic approximation; and (3) Glimm's method for the vibrating string' discovery of exact solutions related to a periodic motion.

44171 (AD-A–206158/8/XAB) **Comparison of basis function and iteration solutions to the Fredholm integral equation of the first kind. Master's thesis.** Carter, M.F. Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). Mar 1989. 71p. (AFIT/GNE/ENP–89M-1). Available from NTIS, PC A04/MF A01.

The purpose of this thesis is to compare methods for solving the Fredholm integral equation of the first kind. The Fredholm equation has several practical applications including geology, superconductivity, and aerodynamics. Of specific interest is its application to determining radiation spectra using data from underground nuclear-effects simulations. The two basic solution methods studied were the basis function and the iteration methods. The basis function method is a representation of the unfolded spectrum by a series of Planckian or cubic spline functions. The iteration method scales the unfolded spectrum so that its weighted integral over a given interval matches that of the actual spectrum. Both basis function methods produced excellent results when the actual spectrum was a sum of its basis functions. The cubic spline method produced unfolded spectra which were good approximations for discontinuous actual spectra. However, there was a significant dropoff of the spectrum for the cubic spline for higher energies. The iteration method produced accurate approximations for actual spectra that were both basis function and discontinuous spectra. There were two problems with this method: the unfolded spectra were discontinuous at the discontinuities of the weighting function and noisy data sometimes produced large discontinuities in the unfolded spectra.

44172 (BiBoS–354/89) **Charge-monopole interaction in Kaluza-Klein theory: A path integral treatment.** Bernido, C.C. Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS). 1989. 17p. (CONF-8901145–: 3. international conference on path integrals from meV to MeV, Bangkok (Thailand), 9-13 Jan 1989). Available from Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS).

The charged particle-monopole system in a five-dimensional spacetime is analyzed by using the Feynman path integral approach. Space and time transformations are necessary in carrying out the path integration. The Green's function is obtained for distances much larger than the radius of the compactified fifth dimension. (orig.).

44173 (BiBoS–357/89) **On a realistic theory for quantum physics.** Duerr, D.; Zanghi, N.; Goldstein, S. Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS). 1989. 20p. Available from Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS).

We discuss some ideas about quantum physics which we think are of relevance for the future evolution of the field. These ideas, though old, are either unknown or misunderstood. Out point here is that a strong realistic position has consequences: It offers a completely natural understanding of 'standard quantum mechanics'; it fully reveals the non-local character of nature; it guides the search of a fundamental unified theory of the microscopic and macroscopic world. (orig.).

44174 (ENEA-RT-TIB–85-28) **Comments on the binomial states of the quantized radiation field.** Dattoli, G.; Gallardo, J.; Torre, A. ENEA, Frascati (Italy). Centro Ricerche Energia. Oct 1985. 12p. Order Number DE89761934/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

In a recent paper, the binomial state (B.S.) of the quantized radiation field was introduced. This new state describes a binomial probability distribution of photons and reduces, under appropriate limits, to either a coherent or to a number state. These states are well-known, their properties have been studied in detail since the pioneering days of quantum optics. They may be generated in many different ways. For example, a classical current generates states with a Poissonian counting probability. Furthermore, it has been stressed that the Jaynes-Cummings Hamiltonian may lead to a binomial counting distribution when, initially, the two-level atom is in the excited state and the field is the vacuum. The interest for the B.S. is mainly due to the fact that, under specific conditions, it produces light which is antibunched, sub-poissonian and squeezed. It has also been shown that the B.S. interpolates between the number and coherent states in the sense that it shares the properties of both. In this paper, a simple physical model is discussed which shows that B.S., or at least binomial counting distributions, can be obtained in the simple physical picture of an electron moving in the field of two counterpropagating waves. Furthermore, it is also pointed out that the antibunched (bunched) radiation can be obtained in a stimulated Thomson scattering.

44175 (INIS-SU–102, pp. 3-6) **Theory of invariants and symmetry of many-particle quantum systems.** Karasev, V.P. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89012199/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 9.

Symmetry of many-particle quantum systems with fundamental "internal" SU(n) symmetry is analyzed. In the space of SU(n)-invariant states a new algebra class of dynamic symmetry generalizing algebras, describing the Green parastatistics at n2, is determined. The possible applications of the results are discussed. 17 refs.

44176 (INIS-SU–102, pp. 21-23) **Stable quantum mechanical systems related to solutions of a triangle scalar equation.** Ushveridze, A.G. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89012199/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 9.

Stable (one-dimensional and multi-dimensional) accurately solvable (AS) and quasi-accurately solvable (QAS) quantum mechanical models are classified. Requirements for hamiltonian hermittivity and model stability cause definite restrictions on spectral parameters. The whole variety of AS an QAS models results from B(λ) function degeneration. The Schroedinger equations for these models are given. It is shown that trigonometrical, hyperbolic and elliptical QAS models exist only in curved spaces and can be classified using the given diagrams. 5 refs.

44177 (INIS-SU–103/A, pp. 34-36) **On the classical formulation of quantum mechanics problems.** Maglaperidze, T.I.; Ushveridze, A.G. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Quantum radiophysics. Collection.* Order Number DE89012203/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 12.

It is shown that quantum mechanics exactly solved models are equivalent to classical models of Coulomb liquid. Quasi-exactly-solved (QES) model reduction to exactly solved ones is described. As an example, the fourth-order rational QES model is considered. 3 refs.

44178 (INIS-SU–103/A, pp. 37-39) **On exact solutions of many-dimensional Schroedinger equations.** Turbiner, A.V.; Ushveridze, A.G. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Quantum radiophysics. Collection.* Order Number DE89012203/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 12.

Regular method of polynomial two-dimensional exact problem solution is suggested. It is based on conformal transformation of Schroedinger equation (SE). Two cases are considered; when the energy in SE is fixed (separate spectrum point is sought) and when it is arbitrary (the whole spectrum is sought). Three classes of exact solutions for discrete spectrum of two-dimensional SE with special form polynomial potentials are constructed. 4 refs.

44179 (IYF–88-105) **Vector fields and gravity on the lattice.** Khatsymovsky, V.M. AN SSSR, Novosibirsk (USSR). Inst. Yadernoj

Fiziki. 1988. 15p. Order Number DE89633885/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The problem of discretization of vector field on Regge lattice is considered. Our approach is based on geometrical interpretation of the vector field as the field of infinitesimal coordinate transformation. A discrete version of the vector field action is obtained as a particular case of the continuum action, and it is shown to have the true continuum limit. 26 refs.; 3 figs.

44180 (JINR-D–17-88-95, pp. 55-58) **Equations of quantum statistical mechanics and equations with counterterms of quantum field theory.** Biryukov, A.A. (Kujbyshevskij Gosudarstvennyj Univ., Kuibyshev (USSR)). Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). (CONF-8708341–: 4. International symposium on selected topics in statistical mechanics, 25-29 Aug 1987). In *4. International symposium on selected topics in statistical mechanics.* Order Number DE89012150/JAW. Available from NTIS (US Sales Only), PC A21/MF A01; INIS.

Equations of quantum statistical mechanics and quantum field theory with counterterms are considered. The main feature of the equations consists in the presence of additional components to the system Hamiltonian with certain physical content. An explicit form of these correlation Hamiltonians is ascertained in particular models. To illustrate the proposed equations a quantum electrodynamics model is considered in the secondary quantization presentation. 2 refs.

44181 (JINR-R–4-88-829) **Some problems of relativistic quantum mechanics with a set number of degrees of freedom.** Lev, F.M. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. 104p. (In Russian). Order Number DE89633869/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

116 p.

Consideration is given to some problems of relativistic quantum mechanics (RQM) of systems with assigned number of degrees of freedom. The arguments are given for the fact that RQM doesn't violate QFT at low energies. From the thechnical point of view RQM is more simple, than QFT, therefore it is suitable for calculation of different relativistic effects at low energies. Method of Sokolov packing operators is discussed in detail. It prescribes the method of construction of generators of Poincare group representation with automatic fuldilment of conditions of relativistic invariance and cluster separability. Particular attention is paid to apparent calculation of hamiltonian of N-particle system in $1/c^2$ approximation, addition of interactions in the framework of Sokolov method. The study is designated for specialists, dealing with calculations of concrete processes in few-nucleon systems, with calculations of relativistic correlations for binding energies.

44182 (ROM2F–89-004) **Variational principles for a relativistic stochastic mechanics.** Marra, R.; Serva, M. Rome Univ. II (Italy). Dipt. di Fisica. 1989. 4p. Order Number DE89633886/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

An extension to the relativistic case of the stochastic variational principles both of Lagrangian and Eulerian type is proposed. The action used is the mean classical action evaluated on the paths of relativistic covariant diffusions. The resulting equations of motion are the relativistic stochastic Lagrange equations. 17 refs.

44183 (SFB–237-49(prepr.)) **Dirichlet forms and generalized Schroedinger operators.** Albeverio, S.; Brasche, J.; Roeckner, M. Bochum Univ. (Germany, F.R.). Sonderforschungsbereich 237 - Unordnung und Grosse Fluktuationen; Bochum Univ. (Germany, F.R.). Inst. fuer Mathematik. May 1989. 31p. Available from Bochum Univ. (Germany, F.R.). Sonderforschungsbereich 237 - Unordnung und Grosse Fluktuationen.

In these lectures we show how Dirichlet forms can be used in order to study very singular perturbations of Schroedinger operators. We also sketch the relation between Dirichlet forms, Markov semigroups and Markov processes. Let us mention that it is precisely the close relations between Dirichlet forms as analytic tools and probabilistic tools which gives a special charm to the theory and its full power. (orig./HSI).

44184 **Random multiplication in a diffusive medium.** Rosenbluth, M. N. (Department of Physics, B-019, University of California, San Diego, La Jolla, California 92093 (US)). *Physical Review Letters (USA),* 63(5): 467-469 (31 Jul 1989).

We consider the problem of multiplication in a diffusive random medium. For time-independent one-dimensional white-noise multiplication "potential" we find asymptotic growth $\sim\exp(t^3)$, while for a "potential" with finite-range correlation we find asymptotic growth $\sim\exp(t^2)$.

44185 **Multivariable Wilson polynomials.** Tratnik, M. V. (Center for Nonlinear Studies and Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545 (US)). *Journal of Mathematical Physics (New York) (USA),* 30(9): 2001-2011 (Sep 1989).

A multivariable biorthogonal generalization of the Wilson polynomials is presented. These are four distinct families, which in a special case occur in two complex conjugate pairs, that satisfy four biorthogonality relations among them. An interesting limit case is the multivariable continuous dual Hahn polynomials.

44186 **Discrete symmetries in periodic-orbit theory.** Robbins, J. M. (Department of Physics, University of California, Berkeley, California 94720 (US)). *Physical Review [Section] A: General Physics (USA),* 40(4): 2128-2136 (15 Aug 1989).

The application of periodic-orbit theory to systems which possess a discrete symmetry is considered. A semiclassical expression for the symmetry-projected Green's function is obtained; it involves a sum over classical periodic orbits on a symmetry-reduced phase space, weighted by characters of the symmetry group. These periodic orbits correspond to trajectories on the full phase space which are not necessarily periodic, but whose end points are related by symmetry. If the symmetry-projected Green's functions are summed, the contributions of the unperiodic orbits cancel, and one recovers the usual periodic-orbit sum for the full Green's function. Several examples are considered, including the stadium billiard, a particle in a periodic potential, the Sinai billiard, the quartic oscillator, and the rotational spectrum of SF_6.

44187 **First-passage time in a bistable potential with colored noise.** Ramirez-Piscina, L. (Department d'Estructura i Constituents de la Materia, Facultat de Fisica, Universitat de Barcelona, Diagonal 647, 08028 Barcelona, Spain (ES)); Maria Sancho, J.; Javier de la Rubia, F.; Lindenberg, K.; Tsironis, G. P. *Physical Review [Section] A: General Physics (USA),* 40(4): 2120-2127 (15 Aug 1989).

A precise digital simulation of a bistable system under the effect of colored noise is carried out. A set of data for the mean first-passage time is obtained. The results are interpreted and compared with presently available theories, which are revisited following a new insight. Discrepancies that have been discussed in the literature are understood within our framework.

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Refer also to citation(s) 42242

44188 (IREQ–7909) **The Varennes tokamak.** Grek, B.; Bolton, R.; Johnston, T.W.; Shkarofsky, I.P.; Van Andel, H. Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). 1979. vp. (CE–02664). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This report summarizes the scientific and technological guidelines for the Varennes tokamak, both machine and program, and includes a very preliminary estimate of cost and schedule. The role of the Varennes magnetic fusion facility in the Canadian national fusion program and the international fusion effort is outlined. Design parameters, machine and plasma, physics, plasma diagnostics, the operation of the machine, and the technological and diagnostic programs are discussed. Impurity control, divertors investigation, and the need for longer plasma pulses in order to simulate the operation of an industrial reactor, are underlined. 2 refs., 26 figs., 1 tab.

44189 (LA-UR–89-2398) **Peregrinations on cold fusion.** Turner, L. Los Alamos National Lab., NM (USA). 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8905126–3: Workshop on cold fusion phenomena, Santa Fe, NM (USA), 23-25 May 1989). Order Number

DE89015259/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Attention is focused on the possibility of resonance-enhanced deuteron Coulomb barrier penetration. Because of the many-body nature of the interactions of room-temperature deuterons diffusing through a lattice possessing deuterons in many of the interstitial positions, the diffusing deuterons can resonate on the atomic scale in the potential wells bounded by the ascending walls of adjacent Coulomb barriers and thereby penetrate the Coulomb barriers in a fashion vastly underestimated by two-body calculations in which wells for possible resonance are absent. Indeed, perhaps the lack of robust reproducibility in cold fusion originates from the narrowness of such transmission resonances. 4 refs., 1 fig.

44190 (UCRL–101583) **Cold confusion.** Chapline, G. Lawrence Livermore National Lab., CA (USA). Jul 1989. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8905143–9: NATO international advanced courses on the nuclear equation of state, Peniscola (Spain), 12 May - 3 jun 1989). Order Number DE89016654/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

On March 23 two chemists, Martin Fleischmann and Stanley Pons startled the world with a press conference at the University of Utah where they announced that they had achieved nuclear fusion at room temperatures. As evidence they cited the production of "excess" amounts of heat in an electrochemical apparatus and observation of neutron production. While the production of heat in a chemical apparatus is not in itself unusual the observation of neutrons is certainly extraordinary. As it turned out, though, careful measurements of the neutron production in electrochemical apparatus similar to that used by Fleischmann and Pons carried out at dozens of other laboratories has shown that the neutron production fails by many orders of magnitude to support the assertion by Fleischmann and Pons that their discovery represents a new and cheap source of fusion power. In particular, independent measurements of the neutron production rate suggest that the actual rate of fusion energy production probably does not exceed 1 trillionth of a watt. This paper discusses the feasibility that cold fusion is actually being achieved. 7 refs.

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Refer also to citation(s) 43794, 43797, 44246, 44259, 44291, 44294, 44400

44191 (DOE/ER/53201–2) **Stellarator Transport Theory.** Hitchon, W.N.G. Wisconsin Univ., Madison, WI (USA). [1989]. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER53201. Order Number DE89016371/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A program of research in Stellarator Transport Theory is described, with emphasis on kinetic modeling of divertor plasmas. We have developed a very efficient numerical solution of the kinetic equation. It was implemented first for the ions, self-consistently with the electrostatic potential, Φ, assuming quasineutrality and a Boltzmann distribution of electron density. The presheath problem has been solved, confirming analytic work in the collisionless limit and extending the earlier work to collisional cases. The effect of a transverse electric field on divertor flows in IMS is to redistribute the diverted flux. We have shown (experimentally) that $\vec{E} \times \vec{B}$ drifts are responsible. We thus used the 'presheath' model to examine the effect of magnetic mirrors along a diverted field line, both on the diverted fluxes and on the electrostatic potential. The calculated variation $\Delta\Phi \sim O(T_e)$ can be expected to set up significant flows. Numerical calculations of the stellarator ambipolar electric field and bootstrap current have been done. Further analytical and computational work on ripple transport is under way, in conjunction with IPP-Garching and as part of the US-USSR collaboration. Our earlier analytic calculations of stellarator ripple transport have also been modified to apply to tokamaks. 11 refs., 5 figs.

44192 (DOE/ER/53244–10) **Reversed field pinch experiments: Progress report.** Colorado Univ., Boulder, CO (USA). Dept. of Chemistry. [1989]. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER53244. Order Number DE89016114/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This report covers the first four months of the eight-month period from 3/24/89 to 11/23/89. This period of time is relatively short, nevertheless significant progress has been made. The paragraphs below describe progress in the following areas: installation of new computers and data acquisition equipment, measurement of ion temperature by Doppler broadening, development of an insertable probe, an experimental study of shell current, and a study of the dependence of ion temperature on fill density. Also described are projects to be completed before November 23, a detailed study of the dependence of resistive wall modes on vertical field index, and a study of the effect of controlled field perturbations on RFP performance. Our plans to increase the plasma current in FY89 by expanding the ohmic heating bank have been modified. The plasma current will be increased by adding an iron core in FY90. The reason for this change is discussed in the FY90 research plan.

44193 (DOE/ER/53266–26) **Equilibrium and stability studies for an iron-core tokamak with a poloidal divertor.** Solano, E.R.; Neilson, G.H.; Lao, L.L. Texas Univ., Austin, TX (USA). Fusion Research Center. 21 Jul 1989. 25p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER53266. (FRCR–338). Order Number DE89016107/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A study of plasma equilibrium and stability in a tokamak with an unsaturated iron core is presented. A spool model is developed for the iron. Both, a simplified force balance code and a Grad-Shafranov solver are used to study the plasma equilibrium. It is observed that the iron can strongly modify the conditions for equilibrium and stability, and in some cases an infinite cylinder model for the iron core is not adequate. New criteria for plasma position stability in the presence of an iron core are introduced. 17 refs., 4 figs., 3 tabs.

44194 (DOE/ER/53266–27) **Plasma position stability studies for TEXT-Upgrade.** Solano, E.R.; Neilson, G.H. Texas Univ., Austin, TX (USA). Fusion Research Center. 21 Jul 1989. 21p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER53266. (FRCR–339). Order Number DE89016108/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A study of the vacuum vessel action on the plasma as a passive stabilizer is presented. The position feedback system is modelled in frequency domain to ascertain if the plasma in TEXT-Upgrade can be stabilized. 4 refs., 3 figs., 3 tabs.

44195 (ENEA-RT-FUS–87-38) **JET high resolution bent crystal spectrometer.** Bartiromo, R.; Bombarda, F.; Giannella, R.; Mantovani, S.; Panaccione, L.; Pizzicaroli, G. ENEA, Frascati (Italy). Centro Ricerche Energia. Jun 1988. 24p. Order Number DE89761965/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

This paper describes the bent crystal spectrometer, of the Johann type, built for the JET tokamak. This high resolution (Lambda/Delta Lambda approx. equivalent to 20000) instrument is characterized by a very long focal length (25 m) allowing the crystal and the position sensitive detector to be placed outside the JET torus hall, in order to keep the background radiation induced noise to an acceptable level. By means of the shape analysis of X-ray lines emitted by medium Z, highly ionized impurities present in the plasma, the ion temperature can be evaluated. Relevant information about other plasma parameters such as electron temperature, impurity ionization equilibrium and concentration, and plasma toroidal velocity can be obtained by means of the analysis of different lines present in the spectra and of their wavelengths. Examples of the results obtained during the first year of operation of this instrument are also illustrated.

44196 (ENEA-RT-FUS–88-06) **Confinement and diffusion in Tokamaks.** McWilliams, R. ENEA, Frascati (Italy). Centro Ricerche Energia. Sep 1988. 17p. Order Number DE89761846/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The effect of electric field fluctuations on confinement and diffusion in tokamaks is discussed. Based on the experimentally determined cross-field turbulent diffusion coefficient, D sub perpendicular approx. = 3.7 cT_e /e B (delta n_i /n_i) rms which is also derived by a simple theory, the cross-field diffusion time, tp = a^2 /D

sub perpendicular, is calculated and compared with experimental results from 51 tokamaks for standard Ohmic operation.

44197 (GA-A–19634) **Recent electron cyclotron heating experiments with low field launch of the ordinary mode on the DIII-D tokamak.** Lohr, J.; Edlington, T.; Groebner, R.J.; Ilin, V.; James, R.A.; Janz, S.; Kalmykov, S.; Luce, T.; Matsuda, Kyoko; Moeller, C.P. General Atomics, San Diego, CA (USA). Jun 1989. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-89ER51114. (CONF-8905159–2: Joint IAEA technical committee meeting on ECE and ECRH and 7th joint workshop on ECE and ECRH (EC-7), 8-11 May 1989). Order Number DE89016665/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In recent ECH experiments on DIII-D, the H-mode regime of improved confinement has been observed using low field launch of the ordinary mode at power levels in excess of 1 MW. This result has been obtained for both the fundamental and second harmonic resonances using ECH as the sole source of auxiliary heating. The approximately linear scaling of the H-mode power threshold with toroidal field has been extended to 2.1 T. The largest stored energies, about 150 kJ for 1.5 MW total input power, occurred when the fundamental resonance was at the center of the discharge, and the stored energy decreased monotonically to the Ohmic value as the resonance location was scanned to the small major radius of the torus. The time derivative of the total energy at the start of the ECH pulse was calculated. Under the questionable assumption that the energy confinement time does not immediately degrade with application of ECH, this indicated that, for central heating, slightly less than half of the injected ECH power was absorbed by the plasma at the fundamental resonance and approximately one third was absorbed when the toroidal field was reduced so that heating was at the second harmonic resonance. Calculated single pass absorption was 85% and 12%, respectively, for these cases. In the case of the second harmonic, substantial conversion to the extraordinary mode takes place upon reflection from the wall following the first pass through the plasma. Despite the poor calculated absorption for the second harmonic, the H-mode transition was clear and showed the characteristic behavior previously observed with extraordinary mode heating. 7 refs., 10 figs.

44198 (GA-A–19676) **A review of recent results with electron cyclotron heating in tokamaks.** Prater, R. General Atomics, San Diego, CA (USA). May 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-89ER51114. (CONF-8905120–21: 8. American Physical Society topical conference on radio frequency power in plasmas, Irvine, CA (USA), 1-3 May 1989). Order Number DE89015217/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Many experiments using Electron Cyclotron Heating (ECH) of plasmas in tokamaks have been reported over the past two years. At a power level of 4 MW, ECH has achieved electron temperatures as high as 10 keV in the T-10 tokamak, and the H-mode has been attained in divertor discharges in DIII-D and JFT-2M. Regarding global energy confinement in either L-mode or H-mode, ECH appears to be quite similar in efficiency to neutral injection, but in addition to bulk heating it has been useful for many purposes, including study of local electron heat diffusivity through pulse modulated heating; suppression of sawteeth, Edge Localized Modes, and other MHD activity; suppression of disruptions; preionization and startup; and current drive. In this paper, progress in these areas which has been reported since the IAEA meeting in 1986 will be summarized. 44 refs.

44199 (IAE–4663/6) **Toroidal rotation retordation and ion anomalous transport by drift waves in a tokamak.** Osipenko, M.V.; Pogutse, O.P.; Shurygin, R.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1988. 20p. (In Russian). Order Number DE89634427/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A set of equations of anomalous rotating plasma hydrodynamics in a weak collision mode with allowance for running - away and trapped particles has been obtained in terms of quasilinear theory taking into account spectra close to those measured experimentally. It is shown that in a banana regime the anomalous transport is determined by ions, the viscosity and thermal conductivity coefficients coinciding within the numerical factor. The scaling obtained for the time of a toroidal rotation slowing down due to anomalous viscosity is in reasonable agreement with the experiment. 14 refs.

44200 (INIS-SU–103/A, pp. 59-61) **On the oscillation spectrum of a thin-wall tubular plasma cylinder excited by REB in a waveguide.** Rukhadze, A.A. (AN SSSR, Moscow (USSR). Inst. Obshchej Fiziki); Selivanov, I.A.; Shkvarunets, A.G. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Quantum radiophysics. Collection.* Order Number DE89012203/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 12.

Results of numerical analysis of electromagnetic oscillation frequency spectrum of a thin-wall tubular plasma cylinder, excited by REB in a circular metallic waveguide under Cherenkov resonance with arbitrary intensity of longitudinal external magnetic field, are presented. 4 refs.; 1 fig.

44201 (INIS-SU–109/A, pp. 35-37) **Influence of a finite magnetic field on the frequency spectrum of electromagnetic oscillations excited by REB in a plasma waveguide.** Guseva, G.I. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics.* Order Number DE89012198/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 10.

Approximate solution of dispersion equation in a finite magnetic field was obtained for the case of high oscillation modes excited by REB in a plasma waveguide. It is shown that new branches of oscillation spectrum appear as compared to approximation of an infinite magnetic field. This affects sufficiently the character of radiation frequency dependence on plasma density. 4 refs.; 1 fig.

44202 (INIS-SU–109/A, pp. 45-47) **Plasma filament ellipticity effect on eigen modes of fast magnetoacoustic wave.** Moroz, P.E. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics.* Order Number DE89012198/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 10.

It is shown that plasma filament ellipticity doesn't prevent the existence of eigen modes of fast magnetoacoustic wave. Field structure and conditions of excitation of various eigen modes were found. 3 refs.; 2 figs.

44203 (IPPCZ–275) **On the stochastic interaction of monochromatic Alfven waves with toroidally trapped particles.** Krlin, L.; Pavlo, P.; Tluchor, Z.; Gasek, Z. Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Ustav Fyziky Plazmatu. Jul 1987. 45p. Order Number DE89634428/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Monochromatic Alfven wave interaction with toroidaly trapped particles in the intrinsic stochasticity regime is discussed. Both the diffusion in velocities and in the radial position of bananas is studied. Using a suitable Hamiltonian formalism, the effect of wave parallel components E-tilde$_{paral}$ and B-tilde$_{paral}$ is investigated. The stochasticity threshold is estimated for plasma electrons and for thermonuclear alpha-particles (neglecting the effect of B-tilde$_{paral}$) by means of direct numerical integration of the corresponding canonical equations. Stochasticity causes transfer between trapped and untrapped regimes and the induced radial diffusion of bananas. The latter effect can considerably exceed neoclassical diffusion. The effect of B-tilde$_{paral}$ was only estimated analytically. It consisted in frequency modulation of the banana periodic motion coupled with a possible Mathieu instability. Nevertheless, for B-tilde$_{paral}$ corresponding to E-tilde$_{paral}$, the effect seems to be weaker than the effect of E-tilde$_{paral}$ when the thermonuclear regime is considered. (author). 14 figs., 36 refs.

44204 (IPPCZ–276) **Numerical simulation of high current relativistic electron flow.** Astrelin, V.T.; Vrba, P. Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Ustav Fyziky Plazmatu. Jun 1987. 18p. (In Russian). Order Number DE89634364/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The numerical results are presented of electron beam generation in high-current diodes with various cathode shapes in the presence of an external longitudinal magnetic field. It is shown that current density near the anode surface strongly depends on the shape of the cathode; for a concave cathode the quasi-hollow beam is generated, for a conical one the beam is almost homogeneous. The propagation of the hollow relativistic electron beam through the anode foil into an evacuated or plasma filled drift tube is also studied. The stationary current of an uncompensated electron beam propagating through the evacuated drift tube is limited by the value of the space-charge limiting current. The numerical simulation of hollow beam propagation through the plasma column showed that the limiting current could be exceeded when an external longitudinal magnetic field was applied. Two-dimensional relativistic electromagnetic current line code "POISSON2" is very useful to optimize the diode design and is capable of determining the beam characteristics in the steady state when no reflexing point is established. (author). 13 figs., 6 refs.

44205 (IPPCZ–278) **Ultrasoft X-ray diagnostics of short living plasmas.** Raus, J.; Piffl, V. Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Ustav Fyziky Plazmatu. Sep 1987. 15p. Order Number DE89634387/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Ultrasoft X-ray plasma diagnostics was implemented by using X-ray diodes with Al photocathodes and submicrometer nitrocellulose filters. The design, clibration and characteristic properties of the apparatus are described. The main results of REB-heated plasma diagnostics are presented as an example of use. (author). 8 figs., 10 refs.

44206 (IPPCZ–279) **Comments on edge turbulence during lower hybrid current drive experiment on CASTOR tokamak.** Stoeckel, J.; Kryska, L.; Zacek, F.; Nanobashvili, S. Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Ustav Fyziky Plazmatu. Mar 1988. 21p. Order Number DE89634365/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Edge plasma electrostatic turbulence is discussed from the point of view of its role in inducing anomalous particle transport. Preliminary results are presented of plasma edge fluctuation measurements obtained in the CASTOR tokamak by using the Langmuir probe technique. The level of edge turbulence found is sufficiently high to explain the anomalous particle losses observed in the ohmic heting regime of the tokamak discharge. On the other hand, it decreases appreciably during the combined lower hybrid current drive and ohmic heating regimes, the particle confinement time simultaneously increasing about twice. Thus, the fluctuation induced transport seems to be responsible for the anomalous particle transport in the CASTOR tokamak. (J.U.). 10 figs., 26 refs.

44207 (IPPJ–892) **Courant condition free modified partially-implicit method. Revised electromagnetic particle code PS2M for bounded plasmas with conducting walls.** Abe, Hirotada; Nakajima, Sadanojyo. Nagoya Univ. (Japan). Inst. of Plasma Physics. Oct 1988. 21p. Order Number DE89906585/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The distortion of the dispersion of the light waves or the nonphysical frequency alias exists in the Courant condition relaxed methods already proposed. The present note proposes a method for correcting this distortion without generating the alias. The proposed method is obtained by merging the merit of one type of methods to another type of method. Nielson and Lindman have developed a 2-dimensional electromagnetic code in which the Maxwell equations are differenced implicitly with respect to time only for the transverse quantities while the equations for the longitudinal quantities and the equations of motion for the charged particles are differenced explicitly. In the present study, the implicit difference equations are modified to remove the Courant restriction of $ck_{max}\Delta t<2$ and to remedy the distortion of numerical dispersion relation of the light waves without affecting its numerical stability and without generating frequency alias. Thus, new equations for the maxwell equations are derived. The proposed method is embodied to the particle code PS2M. It is verified that the method is more effective than those previously presented as for correcting distortion of the dispersion of the light waves without generation of the nonphysical frequency alias. (N.K.).

44208 (IPPJ-DT–143) **Rotating magnetic probe.** Fujiwaka, Setsuya; Matsuura, Kiyokata. Nagoya Univ. (Japan). Inst. of Plasma Physics. Nov 1988. 7p. (In Japanese). Order Number DE89906388/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

A rotating magnetic probe is proposed to measure the plasma current and position of the current channel of tokamaks in long pulse or steady operations; in tokamaks these measurements are important for plasma position control. Basic idea of the structure of the rotating magnetic probe and its characteristics are described. (author).

44209 (IYF–88-116) **Spectroscopic studies of plasma produced in hydrogen-cesium discharge.** Antsiferov, V.V.; Beskorovajnyj, V.V.; Bel'chenko, Yu.I.; Derevyankin, G.E.; Maksimov, A.M.; Pan'kin, V.G.; Skripal', L.P. AN SSSR, Novosibirsk (USSR). Inst. Yadernoj Fiziki. 1988. 21p. (In Russian). Order Number DE89634388/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The plasma of high-current glow hydrogen-cesium discharge with planotron geometry of electrodes is investigated by means of spectroscopic methods. Element and charge composition of the plasma is determined. Dynamics of certain spectral lines of hydrogen, cesium and electrode material - molybdenum at different charge parameters is investigated. Change in densities of atom hydrogen, atom and ionized cesium and electrode sputtering during a charge pulse is traced. H_α and H_β lines per one pulse (10^{-3} s) of a charge are measured with high spectral resolution. Estimations of hydrogen atom temperature and electron concentration in the plasma are obtained. The charge plasma radiation energy in the spectrum range from 400 to 800 nm is measured. 17 refs.; 12 figs.

44210 (JAERI-M–89-020) **Characteristics of edge localized mode in JFT-2M H-mode.** Matsumoto, Hiroshi; Funahashi, Akimasa; Goldston, R.J. and others. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1989. 31p. Order Number DE89906498/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Characteristics of edge localized mode (ELM/ERP) during H-mode plasma of JFT-2M were investigated. It was found that ELM/ERP is mainly a density fluctuation phenomena in the edge, and electron temperature in the edge except just near the separatrix is not very much perturbed. Several experimental conditions to controll ELM/ERP are, plasma density, plasma ion species, heating power, and plasma current ramping. ELM/ERPs found in low density deuterium discharge are suppressed by raising the density. ELM/ERPs are pronounced in hydrogen plasma compared with deuterium plasma. ELM/ERPs seen in hydrogen plasma or in near marginal H-mode conditions are suppressed by increasing the heating power. ELM/ERPs are found to be suppressed by plasma current ramp down, whereas they are enhanced by current ramp up. MHD aspect of ELM/ERP was investigated. No clear MHD features of ELM/ERP were found. However, reversal of mode rotation seen imediately after ELM/ERP suggests the temporal return to L-mode during the ELM/ERP event. (author).

44211 (JAERI-M–89-033) **Review of JT-60 experimental results from June to October, 1988.** Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1989. 273p. Order Number DE89906468/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

After the achievement of AEC (Atomic Energy Commission) milestone in October, 1987, a new divertor coil has been installed to produce divertor plasmas with a single null at the buttom. A pellet injector was also installed during the same shut down period. This report presents the results from the experiment held from June to October in 1988. Major experimental issues during this phase are: (1) confinement and (2) divertor characteristics of lower X-point discharges, (3) enhancement of confinement with pellet injection, (4) ion heating with ICRF of LHRF, (5) current drive with LHRF or ICRF, and evaluation of bootstrap current. (J.P.N.).

44212 (JET-R–89-02) **Coupling of slow waves near the lower hybrid frequency in JET: implications for the launcher design.** Litaudon, X.; Moreau, D. Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. 1989. 23p.

Order Number DE89634366/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The physical and coupling properties of the JET Lower Hybrid antenna have been investigated numerically with a 2-D computer code based on the linear coupling theory. The antenna utilises an array of multijunction units and their "self-adaption" property is analysed. The geometrical parameters of the multijunction unit have been properly optimised (choice of the location of the E-plane junctions, wall thickness) and their values have been taken into account in the launcher manufacture. With such an optimisation, power reflection coefficient below 1.5% and directively based on the current drive efficiency between 60% to 70% are expected at the optimum plasma density ($n_e \simeq 10^{18}$ m^{-3}). Edge effects are minimised using two shorted passive waveguides on each side of the antenna. Finally the accessibility limit on the coupling is investigated. (Author).

44213 (JET-R–89-03) **Neoclassical transport calculations using the impurity transport code 'STRAHL'.** Behringer, K. Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. 1 Feb 1989. 47p. Order Number DE89634392/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The impurity transport code 'Strahl', already providing some rudimentary neoclassical transport facilities, has been described in a previous report. The code has been amended to include different collisionality regimes of impurity and plasma ions, and to allow a second impurity species to be specified and included in the transport calculations. More input parameters have been defined, which were necessary for the more detailed transport coefficients, but also give greater flexibility in the modelling of actual plasma pulses. Finally, the possibility of following the evolution of plasma parameters by means of a sequence of code re-entries has been facilitated, and a number of minor changes were made, which were thought to be necessary or convenient. The present report gives an account of the equations used in the above amendments, and of the ideas behind other changes made. New listings of the code 'STRAHL' and relevant subroutines are appended. Furthermore, a brief description and a listing of the program 'NEPLO' are included, an indispensable prerequisite for displaying all input parameters to 'STRAHL', which is using the same subroutines for calculating transport coefficients, as well as atomic data and radiation. (Author).

44214 (JET-R–89-05) **Transport analysis using the TRANSP code.** Balet, B.; Stubberfield, P.M. Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. 1989. 52p. Order Number DE89634393/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

TRANSP is a time dependent transport analysis code. Experimental data is used wherever possible to define plasma parameters, and models similar to those found in simulation codes are used to supplement this data. TRANSP first solves the magnetic field diffusion equation and then uses the particle and energy conservation equations to calculate local transport coefficients. The code also produces simulations of certain diagnostic measurements which can be used as consistency checks. Obtaining good results from TRANSP is strongly dependent on the reliability of the experimental data and on an understanding of the limitations of the various diagnostic measurements. This report contains a detailed discussion of a typical transport analysis. Section II describes the various experimental data which can be provided as input to TRANSP either through a namelist or in a user PPF and indicates the relative importance of specific data in a simulation. Section III gives details of some of the additional physical quantities which must be defined before running TRANSP and some of the controls that are available to determine the way in which the data is used within the code. Section IV is a description of a full transport analysis of a typical JET H-mode shot. Section V contains conclusions and general remarks on transport analysis using TRANSP. (Author).

44215 (LA–11622-MS) **Electron temperature measurements of field-reversed configuration plasmas on the FRX-C/LSM experiment.** Rej, D.J. Los Alamos National Lab., NM (USA). Sep 1989. 46p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. Order Number DE89016187/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A single-point Thomson scattering diagnostic is used to determine the electron temperature T_e of field-reversed-configuration (FRC) compact toroids generated in the θ-pinch source of the Los Alamos FRX-C/LSM experiment. Measurements are performed close to the axial midplane and near the magnetic and geometric axes. A broad range of plasma conditions is investigated and electron temperatures vary, on average, between 90 and 190 eV. For a given condition, T_e remains relatively constant during the 60 μs measurement interval between formation and the onset of the n = 2 rotational instability. T_e increases with plasma diameter and external magnetic field, and decreases slightly with fill pressure. The temperature at the geometric axis is consistently 10–20% lower than that near the field null. The temperature is approximately 35% higher than observed previously on the smaller FRX-C device. The implications of these measurements on plasma confinement properties are discussed. 25 refs., 18 figs., 8 tabs.

44216 (LA-UR–89-2474) **Observations of azimuthal asymmetry for certain FRC operating regimes.** Wright, B.; Barnes, D.; Chrien, R.; Crawford, E.; Milroy, R.; Okada, S.; Siemon, R.; Tuszewski, M.; Webster, R. Los Alamos National Lab., NM (USA). 1989. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8903100–4: 9. U.S. compact toroid symposium, Union. WA (USA), 14-15 Mar 1989). Order Number DE89015300/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The FRX-C/LSM experiment has been operated with additional diagnostics for studies of FRC structure in the θ-pinch source. Data were taken over ranges of fill pressure and bias field that lead to the formation of FRCs with confinement properties that are consistently good (e.g., at 3 mtorr at 0.7 kG bias) and consistently poor (e.g., at 5 mtorr at any bias). The pertinent diagnostics were end-on soft x-ray imaging, arrays of external B_θ and B_r probes, and five chords of interferometry. The data show that easily observed departures from azimuthal (θ) symmetry occur in some cases and that further research into the cause and nature of these asymmetries would benefit our studies of FRC stability and confinement. 4 refs.

44217 (LBL–26813) **Analytic theory of ICRF minority heating.** Ye, H.; Kaufman, A.N. Lawrence Berkeley Lab., CA (USA). Apr 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8905120–22: 8. American Physical Society topical conference on radio frequency power in plasmas, Irvine, CA (USA), 1-3 May 1989). Order Number DE89015222/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We present a one-dimensional analytic theory of the ICRF gyroresonant absorption and mode-conversion, for the problem of minority fundamental resonance. Using the wave phase-space method, and the theory of linear mode conversion therein, we obtain explicit expressions for the coefficients of transmission (T), reflection (R), conversion (C), absorption (A). 7 refs., 2 figs.

44218 (LBL–27108) **Scattering of an ICRF magnetosonic wave by plasma density turbulence.** Cook, D.R.; Kaufman, A.N. Lawrence Berkeley Lab., CA (USA). Apr 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8905120–20: 8. American Physical Society topical conference on radio frequency power in plasmas, Irvine, CA (USA), 1-3 May 1989). Order Number DE89015223/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A fast ICRF magnetosonic wave, launched into a tokamak plasma, scatters off turbulent density fluctuations in the plasma edge. We use cold-fluid theory to calculate the angular distribution of the scattered wave and find it to be predominantly perpendicular to the incident wavevector for second harmonic majority heating. We calculate the mean free path and find it to be large compared to the size of tokamak devices. Therefore, scattering of ICRF magnetosonic waves by density turbulence is an utterly negligible effect. 2 refs., 1 fig.

44219 (PPPL–2640) **The effect of ICRF antenna phasing on metal impurities in TFTR.** Stevens, J.E.; Bush, C.; Colestock, P.L.; Greene, G.J.; Hill, K.W.; Hosea, J.C.; Phillips, C.K.; Stratton, B.; von Goeler, S.; Wilson, J.R.; Gardner, W.; Hoffman, D.; Lysojvan, A. Princeton Univ., NJ (USA). Plasma Physics Lab. Jul 1989. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE89014009/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

ICRF power levels of up to 2.8 MW were achieved during the 1988 experimental run on TFTR. Metal impurity concentrations (Ti, Cr, Fe, Ni) and Z_{eff} were monitored during ICRF heating by x-ray pulse height analysis and uv spectroscopy. Antenna phasing was the key variable affecting ICRF performance. No increase in metallic impurities was observed for $P_{rf} \lesssim 2.8$ MW with the antenna straps 0-Π, while a measurable increase in titanium (Faraday screen material) was observed for $P_{rf} \gtrsim 1.0$ MW with 0-0 phasing. 18 refs., 8 figs.

44220 (UCID–21636) **Simultaneous multiple frequency interferometry: An application of homodyne phase measurement.** Bolton, P.R. Lawrence Livermore National Lab., CA (USA). 1 May 1989. 19p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89013975/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Microwave interferometry of plasmas involving only multiple homodyne phase measurement is considered in the limits of very low and very high collisionality. Starting with an assumed Langevin model of a weakly ionized gaseous plasma the expressions for the complex propagation constant(s) of probe(s) are simplified for these limiting cases. Emphasis is on the imaginary component of the propagation constant which accounts for the phase shifting phenomena. Simultaneous use of two probing frequencies enables phase determination of both the time-dependent electron density and 'effective' collision rate which are line-integrated along the probe propagation length. Extension to a triple frequency interferrometric system allows additional determination of the line-integrated square of the electron density due to the incorporation of higher order terms in a Taylor series expansion. If a reasonable functional form for the longitudinal variation in plasma density is assumed, the plasma spatial profile can then be estimated. Throughout, plasmas are assumed to be transversely uniform. In addition, physical interpretation of a real 'effective' collision rate can be simplified in these collisional limits to be directly proportional to an energy distribution averaged momentum transfer rate. 8 refs., 1 fig.

44221 (UCRL–21188) **Generation of $(3/2)\omega_0$ radiation in inhomogeneous plasmas under the irradiation of intense electromagnetic waves: Final report, April 3, 1987–September 30, 1988.** Wong, A.Y.; Bauer, B.S. Lawrence Livermore National Lab., CA (USA); California Univ., Los Angeles, CA (USA). Dept. of Physics. Feb 1989. 116p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89015723/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

We have investigated several phenomena of importance to laser-plasma interactions that are associated with cavitons generated at the critical layer of a nonuniform plasma by resonant absorption of intense electromagnetic radiation. The emission, from deep cavitons, of electromagnetic radiation at half-harmonics of the pump frequency, has been examined. Caviton formation has been shown to be most efficient for shallow density gradients at the critical layer. Huge electron plasma waves, with attendant wave-breaking and energetic particle production, have been generated. Experimental results are consistent with LLNL and UCLA computer simulations.

44222 Research opportunities below 300 nm at the NBS free-electron laser facility. Debenham, P.H. (9500984); Johnson, B.C. vp. of Free-electron laser applications in the ultraviolet. Optical Society of America, Washington, DC (1988). (CONF-880318–: Topical meeting on free-electron laser applications in the ultraviolet, Cloudcroft, NM (USA), 2-5 Mar 1988).

A free-electron laser (FEL) user facility is being constructed at the Center for Radiation Research of the National Bureau of Standards in collaboration with the Plasma Physics Division of the Naval Research Laboratory. The FEL, which is driven by the NBS-LANL cw racetrack microtron (RTM), is operated as an oscillator with the fundamental wavelength variable from approximately 200 nm to 10 μm. The presence of harmonics should allow for operation in the VUV and EUV spectral regions. The NBS-LANL cw RTM consists of a 5 MeV injector section and a 12 MeV, cw, rf linear accelerator (linac). The linac is placed between two uniform-field end magnets that recirculate the beam on successive orbits through the linac. The beam can be deflected out of the RTM after completing up to and including 15 passes through the linac, so that the final beam energy is 17 MeV to 185 MeV.

44223 Whistler-mode electron cyclotron emission from the Phaedrus-B end cell. Cui, B. (9525160); Probert, P.H.; Brooker, P.D.; Nonn, P.D.; Keil, D.L.; Hershkowitz, N.; Majeski, R.P.; Breun, R.A.; Ellis, R.F. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 17(1): 34-40 (Feb 1989).

Measurements of whistler-mode electron cyclotron emission have been made in the Phaedrus-B tandem mirror end cell. The receiving horn was located on the axis of the machine just outboard of the end cell. Under normal conditions, the signal had a component which was identified as blackbody emission, and an electron temperature was obtained which was in good agreement with electron end loss energy-analyzer data. In addition, the signal contained short bursts of unknown origin. Significant heating of the electrons due to end-cell ICRF was seen. Comparison of end loss and Thomson scattering data showed that emission from hotter edge electrons was responsible for a large part of the total signal.

44224 Electron temperatures of intense electron-beam-produced plasmas. Brake, M.L. (4142000); Repetti, T.E. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 17(1): 60-61 (Feb 1989).

A method of estimating the electron temperatures in intense, relativistic, electron-beam-produced plasmas is presented. This method compares spectral line intensities obtained from visible emission spectroscopy to those expected from LTE plasmas. The line intensities, however, particularly those originating from highly excited states, are corrected dor the effects of the fast beam electrons.

44225 Ray tracing study of the electron cyclotron current drive in DIII-D using 60 GHz. Matsuda, K. (9524084). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 17(1): 6-11 (Feb 1989).

The efficiency of the electron cyclotron current drive using 60 GHz sources in the DIII-D tokamak has been numerically investigated for the following cases: The inside-launched fundamental extraordinary mode, the outside-launched fundamental ordinary mode, and the outside-launched second harmonic extraordinary mode. In the limit-weak ECH power and for plasma parameters relevant for experiments, illumination of the plasma with inside-launched fundamental extraordinary mode is found to have the highest efficiency.

44226 Experimental study of CF_4 conical theta pinch plasma expanding into vacuum. Pedrow, P.D. (9500381); Nasiruddin, A.M. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 17(1): 17-23 (Feb 1989).

Langmuir probe, photodiode, and optical multichannel analyzer (OMA) measurements have been made on a pulsed CF_4 conical theta pinch plasma. A cloud of CF_4 gas was puffed into a conical theta pinch coil, converted to plasma, and propelled into the vacuum region ahead of the expanding gas cloud. At a position 67 cm away from the conical theta pinch coil, the plasma arrived in separate packets that were about 20 μs in duration. The average drift velocity of these packets corresponded to an energy of about 3 eV. The OMA measurements showed that the second packet contained neutral atomic fluorine as well as charged particles.

44227 Summary of the National Aeronautics and Space Administration Lunar Helium-3/Fusion Power Workshop, Cleveland, Ohio, April 25-26, 1988. Epstein, G.L. (Congress of the United States Office of Technology Assessment, Washington, DC (US)); Plescia, J.B.; Gabris, E.A. *Fusion Technology (USA),* 15(1): 67-77 (Jan 1989).

The National Aeronautics and Space Administration (NASA) Lunar Helium-3/Fusion Power Workshop was held April 25-26, 1988, in Cleveland, Ohio, to discuss the feasibility of mining ^{3}He from the lunar regolith for use in terrestrial fusion applications, which was said to offer an economic payoff for space missions. The development of the moon as a source of materials for use on earth is being studied by NASA's Office of Exploration as a potential next step in extending human presence into the solar system. The discovery in 1985 of useful quantities of ^{3}He on the moon makes this assessment particularly timely. Forty-five experts from the nuclear fusion,

mining, and lunar communities participated. An overview of mining ^{3}He from the moon and two applications concepts were presented at the opening session of the workshop.

44228 Recycling and neutral transport in the DIII-D tokamak. Allen, S.L. (Lawrence Livermore National Lab., CA (USA)); Rensink, M.E.; Hill, D.N.; Perkins, D.E.; Jackson, G.L.; Ali Mahdavi, M. DIII-D Research Team. *Journal of Nuclear Materials, on Metallurgy, Ceramics and Solid State Physics in the Nuclear Energy Industry (Netherlands),* 162-164: 164 (Apr 1989). DOE Contract W-7405-ENG-48;AC03-84ER51044. (CONF-8805285–: 8. international conference on plasma surface interactions in controlled fusion devices (PSI-8), 2-6 May 1988).

Also published as report GA-A–19292; CONF-880512–7.

Several diagnostics have been used to characterize the edge plasma in the DIII-D divertor region and thereby to understand the particle recycling and neutral particle transport in an open divertor. An array of Langmuir probes mounted on the carbon divertor plates determines that generally the electron temperature is low ($T_e \simeq$10-20 eV), and the electron density is high ($n_e \simeq 5x10^{19}$ m^{-3}). The edge plasma temperature and density are also measured by a moveable Langmuir probe mounted at the midplane of the plasma; the data from these shot-by-shot edge radial scans are then connected with the data for the core plasma obtained by Thomson scattering. The heat flux to the divertor plates is measured by an absolutely calibrated infrared camera; a plasma model is used to compare the heat flux with the measured T_e and n_e. The molecular neutral pressure at the edge of the plasma at several poloidal and toroidal locations is obtained from absolutely-calibrated pressure gauges; a gas puff enables in-situ gauge calibrations before each plasma shot. Typically, the divertor pressure is 10-50 times larger than that at the midplane. Time-resolved H_α brightness measurements are obtained from an absolutely calibrated television camera viewing the divertor region from above; both strike points are viewed simultaneously. The emission from the inner and outer strike points are usually equal after the H-mode transition, but are often unequal after the first ELM in H-mode and during some phases of L-mode discharges. A tangential camera measures the falloff in emission from the X-point to the plasma midplane. (orig./KP).

44229 Boundary asymmetries and plasma flow to the ALT-II toroidal belt pump limiter. Corbett, W.J. (California Univ., Los Angeles, CA (USA). Inst. of Plasma and Fusion Research); Goebel, D.M.; Conn, R.W.; McGrath, R.T.; Dippel, K.H.; Finken, K.H. *Journal of Nuclear Materials, on Metallurgy, Ceramics and Solid State Physics in the Nuclear Energy Industry (Netherlands),* 162-164: 164 (Apr 1989). DOE Contract FG03-85ER51069. (CONF-8805285–:).

The ALT-II toroidal belt pump limiter is constructed with 8 radially adjustable limiter blade segments located 45^0 below the outboard horizontal midplane of TEXTOR. An array of Langmuir probes installed in the plasma scoops measures the total ion current to each neutralizer plate, including asymmetries in flow incident from above and below the belt. Recent measurements indicate that 10-50% more current is collected by neutralizers with flux tubes connecting to the electron drift side, on the outboard side of ALT-II. The source of the particle collection asymmetry is deduced from profile measurements in the scrape-off layer (SOL). On the outboard midplane, a scanning double probe measures λ_n=1.4 cm, while profiles obtained with a Li-beam diagnostic located at the bottom of TEXTOR show λ_n=0.9 cm. The primary source of the asymmetric particle collection at the neutralizers is therefore the difference between e-folding lengths on the electron and ion drift sides. During ohmic discharges, the electron temperature in the center of the scoops (3 cm into SOL) is 8-12 eV, tending to decrease with rising line average density in the core. Corresponding edge plasma densities are in the range (2-5)x10^{11} cm^{-3}. In this paper, we report on measurements in the SOL behind ALT-II to emphasize the role of asymmetric decay lengths on particle collection by the ALT-II toroidal belt pump limiter. (orig.).

44230 Armature formation in a railgun using a two-stage light-gas gun injector. Hawke, R.S. (9513035); Susoeff, A.R.; Asay, J.R.; Hall, C.A.; Konrad, C.H.; Hickman, R.J.; Sauve, J.L. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 17(3): 378-385 (Jun 1989).

During the past decade several research groups have tried to achieve reliable acceleration of projectiles to velocities in excess of 8 km/s by using a railgun. All attempts have met with difficulties. However, in the past four years the researchers have come to agree on the nature and causes of the difficulties. The consensus is that the hot plasma armature - used to commutate across the rails and to accelerate the projectile - causes ablation of the barrel wall; this ablation ultimately results in parasitic secondary arc formation through armature separation and/or restrike. The subsequence deprivation of current to the propulsion armature results in a limit to the achievable projectile velocity. Methods of mitigating the process are under study. One method uses a two-stage light-gas gun as a preaccelerator/injector to the railgun. The gas gun serves a double purpose: It quickly accelerates the projectile to a high velocity, and it fills the barrel behind the propulsive armature with insulating gas. While this approach is expected to improve railgun performance, it also requires development of techniques to form the propulsive armature behind the projectile in the high-velocity, high-pressure gas stream. This paper briefly summarizes the problems encountered in attempts to achieve hypervelocities with a railgun. Included is a description of the phenomenology and details of joint Sandia National Laboratories, Albuquerque/Lawrence Livermore National Laboratory (SNLA/LNLL) work at SNLA on a method for forming the needed plasma armature.

44231 Operating characteristics and modeling of the LLNL 100-kV electric gun. Osher, J.E. (9513035); Barnes, G.; Chau, H.H.; Lee, R.S.; Lee, C.; Speer, R.; Weingart, R.C. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 17(3): 392-402 (Jun 1989).

In the electric gun, the explosion of an electrically heated metal foil and the accompanying magnetic forces drive a thin flyer plate up a short barrel. Flyer velocities of up to 18 km/s make the gun useful for hypervelocity impact studies. The authors briefly review the technological evolution of the exploding-metal circuit elements that power the gun, describe the 100-kV electric gun designed at Lawrence Livermore National Laboratory (LLNL) in some detail, and present the general principles of electric gun operation. They compare the experimental performance of the LLNL gun with a simple model and with predictions of a magnetohydrodynamics code.

44232 Computer-based on-line pulsed ionization chamber plasma diagnostic system. Choi, W.Y. (Univ. of Florida, Gainesville (USA)); Park, J.S.; Baumgartner, M.J.; Ellis, W.H. *Transactions of the American Nuclear Society (USA),* 57: 306-308 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

A pulsed ionization chamber (PIC) plasma diagnostic system described previously for use in the study of ionized gas kinetics for rare gases and their mixtures including He(UF_6)-a candidate gas core reactor/magnetohydrodynamic (MHD) converter working fluid and a component in wide range radiation field measurement systems has been upgraded in performance to include computer-controlled data acquisition, storage, processing, graphic analysis, and presentation. The current automated system, whose performance is being reported and whose block diagram is shown, is developed around a Macintosh SE microcomputer, IEEE-488 (GPIB) instruments, and a National Instruments interface controller. The results shown not only demonstrate the improved wide-range voltage signal measurement capability of the new PIC system (e.g., from millivolts to tens of volts) but also illustrate the system's capability of easily producing print-ready graphics of experimental data. From automation to report preparation, the new system promises to greatly facilitate the overall process of our experimental plasma diagnostic program and should aid in the implementation in our study of a series of gas core reactor fuel gas/MHD converter working fluids.

44233 Magnetic-probe diagnostics for railgun plasma armatures. Parker, J.V. (9512470). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 17(1): 487-500 (Jun 1989).

Magnetic probes were employed on the first plasma armature railgun experiments, and they have been used continuously since then for position determination and qualitative determination of the armature current. In the last few years, improvements in experimental

technique and analysis have permitted more accurate measurements of the plasma-armature current distribution. This paper reviews the various probe configurations in use today and presents analytic approximations for the dependence of the probe signal on probe location and railgun geometry. Rail current and armature current probes are compared and contrasted with respect to resolution and accuracy. Further improvements in measurement accuracy are predicted for close-spaced magnetic-probe arrays.

44234 Ion thermal confinement in the enhanced-confinement regime of the TFTR tokamak. Fonck, R. J. (Princeton Plasma Physics Laboratory, Princeton, New Jersey 08543 (US)); Howell, R.; Jaehnig, K.; Roquemore, L.; Schilling, G.; Scott, S.; Zarnstorff, M. C.; Bush, C.; Goldston, R.; Hsuan, H.; and others. *Physical Review Letters (USA),* 63(5): 520-523 (31 Jul 1989). DOE Contract AC02-76CH03073.

Central ion temperatures up to 30 keV and rotation speeds up to 8×10^5 m/sec have been confirmed with new diagnostic measurements in the TFTR hot-ion enhanced-confinement regime, and the ion thermal diffusivity is found to be non-neoclassical and comparable to the anomalous electron thermal diffusivity. The dominant effect of strong rotation is the down-shifting of the neutral beam energies in the plasma frame, which results in reduced ion and electron heating on axis, and the presence of off-axis ion heating from viscous damping of the plasma rotation.

44235 Warm plasma dispersion relation of the fast Alfven wave for asymmetrical heating current drive. Gahl, J.M. (9523873); Hagler, M.O.; Kristiansen, M. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 17(3): 520-523 (Jun 1989).

Experimental observation of current drive by asymmetrical heating of ions in the Texas Tech Tokamak suggests that penetration of the fast Alfven wave near the fundamental ion-cyclotron resonance is restricted. The numerical study of the warm plasma dispersion relation near the ion-cyclotron resonance does indeed show this effect. The study reveals that as the wave approaches the resonant layer from the high or low field side of the torus, it first passes through a region where asymmetrical heating takes place and the wave energy is absorbed by ions moving with high velocity parallel to the magnetic field.

44236 Quasilinear ballooning mode saturation. Riedel, K. S. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012 (US)). *Physics of Fluids B: Plasma Physics (USA),* 1(9): 1780-1787 (Sep 1989).

At small amplitudes, resistive ballooning modes form a quasilinear sheet current, which opposes the magnetic flux reconnection. In the ensuing Rutherford regime [Phys. Fluids **16**, 1903 (1973)] the sheet current at each resonance surface decays. To remain in a quasistatic equilibrium, magnetic islands form and thereby flatten the pressure at each resonance surface. For local instabilities, a spectrum of modes are excited, each flattening the pressure gradient at its resonance surface. The resulting averaged quasilinear pressure profile has a Cantor setlike structure. Using the equivalence of harmonics, the calculation of the saturated amplitudes is reformulated as a nonlinear eigenvalue problem of an integral differential equation with the quasimode formalism.

44237 Self-adjoint formulation of plasma heating in the ion-cyclotron range of frequencies. Romero, H. (Department of Physics, University of California, Los Angeles, California 90024-1547 (US)); Morales, G. J. *Physics of Fluids B: Plasma Physics (USA),* 1(9): 1805-1810 (Sep 1989).

It is shown that second-order (ρ/L) corrections in the expression for the equilibrium distribution function are required to obtain a self-adjoint system of equations for ion cyclotron range of frequencies (ICRF) wave propagation in a nonuniform plasma (ρ denotes the ion-Larmor radius and L the gradient scale length). Self-adjointness results in energy conservation in the absence of absorption mechanisms, as expected. A Lagrangian density is obtained, which yields both the wave operator and its adjoint, and directly results in the conservation law of the truncated system.

44238 The effect of low-frequency turbulence on flux, particle, and energy confinement in a field-reversed configuration. Krall, N. A. (Krall Associates, Del Mar, California 92014 (US)). *Physics of Fluids B: Plasma Physics (USA),* 1(9): 1811-1817 (Sep 1989).

A recent stability calculation solved the dispersion matrix to find three distinct unstable modes in three distinct regions of the field-reversed configuration (FRC). In the present work the transport produced by these three low-frequency modes is calculated, and both global transport scaling estimates and local transport coefficients are obtained. The result is that low-frequency drift wave transport agrees with most present experimental measurements of particle, flux, and energy loss both in terms of magnitude and scaling, becoming less dominant as the collision frequency decreases.

44239 Wave propagation in the ion cyclotron range of frequencies through the turbulent edge. Thayer, D. R. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720 (US)). *Physics of Fluids B: Plasma Physics (USA),* 1(9): 1818-1826 (Sep 1989).

It is pointed out that the turbulent tokamak edge can significantly affect the transmission of a wave in the ion cyclotron range of frequencies during auxiliary heating at the resonant layer. Because of the large edge density fluctuations, it is necessary to consider an order unity expansion parameter for the general propagator theory of wave propagation. Consequently, a renormalized theory for the scattering process is developed and utilized to determine the backscattering (one dimensional) and spectral wavenumber spread (two dimensional) of incident energy.

44240 Results of counterneutral beam injection on the DIII-D tokamak. Schissel, D. P. (General Atomics, San Diego, California 92138 (US)); Allen, S. L.; Burrell, K. H.; DeBoo, J. C.; Groebner, R. J.; Kellman, A. G.; Ohyabu, N.; Petersen, P. I.; Sager, G. T.; Snider, R. T.; and others. *Physics of Fluids B: Plasma Physics (USA),* 1(9): 1843-1849 (Sep 1989).

Limiter, single-null, and double-null divertor plasmas have been heated by hydrogen neutral beam injection in the direction opposite to that of the plasma current. The H-mode power threshold is reduced by approximately 25% for counterinjection. Sawtooth suppression was possible only for high neutral beam power and for high values of the safety factor. No confinement improvement over similar coinjection discharges was observed in H-mode, L-mode, or limiter discharges. In plasmas without sawteeth, metallic impurity buildup in the central region of the plasma eventually leads to a reduction in confinement. The parametric dependence of energy confinement for both L-and H-mode plasmas was found to behave in the same manner during similar coinjection experiments. H-mode confinement increased linearly with increasing plasma current (65 msec/MA at 9 MW). Both L-mode and H-mode energy confinement decreased with increasing neutral beam power. At 1.25 MA, the L-mode plasmas had a confinement time that was less than that predicted by Kaye–Goldston scaling.

44241 Evidence for the modification of half-harmonic spectral shifts by plasma flow. Gabl, E. F. (KMS Fusion, P.O. Box 1567, Ann Arbor, Michigan 48106 (US)); Berger, R. L.; Busch, G. E.; Campbell, P. M.; Schroeder, R. J.; Shepard, C. L.; Tarvin, J. A. *Physics of Fluids B: Plasma Physics (USA),* 1(9): 1850-1854 (Sep 1989).

The (3)/(2) ω_0 harmonic emission has been observed from a laser-produced plasma using exploding foil targets illuminated by 1.053 μm laser light with a 300 psec square pulse. The shift of the measured wavelength from (2)/(3) λ_0 is found to depend markedly on the target thickness. Variation of the flow velocity and thus the Doppler shifts of the wave frequency with target thickness is found to be more important than variation of the electron temperature. Adjusting the measured wavelength by Doppler shifts calculated with flow velocities from simulations brings the measurements from different target thicknesses into agreement. These results indicate that previous predictions of electron temperatures from analyses of half-harmonic spectra from inertial confinement fusion plasmas are up to a factor of 2 too small.

44242 Propagation of a Gaussian beam in a nonhomogeneous plasma. Mazzucato, E. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08543 (US)). *Physics of Fluids B: Plasma Physics (USA),* 1(9): 1855-1859 (Sep 1989).

The asymptotic theory of Choudhary and Felsen [IEEE Trans. Antennas Propag. **AP-21**, 827 (1973)] on the propagation of scalar inhomogeneous waves in two-dimensional isotropic media is extended to the case of three-dimensional vector fields. The theory is applied to the propagation of Gaussian beams in nonhomogeneous media. The wave trajectory equations are then reformulated for anisotropic media and used for tracking a Gaussian beam in a tokamak plasma.

44243 Observation of enhanced x-ray emission from long-pulse-width laser-produced plasmas. Ze, F. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550 (US)); Kania, D. R.; Langer, S. H.; Kornblum, H.; Kauffman, R.; Kilkenny, J.; Campbell, E. M.; Tietbohl, G. *Journal of Applied Physics (USA)*, 66(5): 1935-1939 (1 Sep 1989). DOE Contract W-7405-ENG-48.

Experiments investigating the pulse-width dependence of thermal x-ray conversion efficiencies ($h\nu$<1.5 keV) in laser-heated gold plasmas are described. The results show that the instantaneous ratio of the emitted x-ray flux to the laser energy deposition rate increases throughout a 4-ns laser pulse. The studies were carried out using single arms of the 10-beam Nova laser facility. The irradiance was ~4–5x10^{14} W/cm^2 in the target plane as we varied the laser pulses' FWHM from 2 to 4 ns. The laser pulses were nominally flat-topped and contained between 1 and 2 kJ of (1)/(3) μm light. Time-resolved plasma radiation was monitored with a broadband, streaked x-ray spectrograph that has a roughly 30-ps time resolution and channels that are roughly 100–150 eV wide. One-dimensional numerical models run with the lasnex code produce a conversion efficiency that is nearly constant throughout the laser pulse. We discuss various approximations made in the one-dimensional models and conclude that none of them are a likely explanations for the increase of conversion efficiency with time. A preliminary two-dimensional model of a disk heated by a 3-ns pulse shows that the conversion efficiency increases throughout the pulse. The increase is due to soft x rays emitted from outside the laser spot. Further experiments and modeling will be carried out to assess these two-dimensional effects.

44244 Anomalous particle pinch for collisionless plasma. Terry, P. W. (Department of Physics, University of Wisconsin Madison, Madison, Wisconsin 53706 (US)). *Physics of Fluids B: Plasma Physics (USA)*, 1(9): 1932-1934 (Sep 1989).

The particle transport arising from the convection of nonadiabatic electron density by ion temperature gradient driven turbulence is examined for trapped electron collisionality regimes. In the lower temperature end of this regime, trapped electrons are collisional and the particle flux is outward (in the direction of the gradients). When the trapped electrons are collisionless, there is a temperature threshold above which the electron temperature gradient driven particle flux changes sign and becomes inward. The magnitude of the nonadiabatic electron contribution to the growth rate is found to be potentially of the same order as the ion contribution.

44245 Note on detailed models for trapped electron transport in tokamaks. Waltz, R. E. (General Atomics, San Diego, California 92138-5608 (US)); Dominguez, R. R. *Physics of Fluids B: Plasma Physics (USA)*, 1(9): 1935-1937 (Sep 1989).

Detailed quasilinear trapped electron transport expressions are compared with the simple scaling forms of the extreme dissipative regime used in recent modeling studies. The problem of obtaining a consistent plasma pinch in the dissipative regime is discussed.

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Refer also to citation(s) 42509, 42711, 42712, 42882, 42941, 42944, 43071, 43080, 43081, 43082, 43122, 43308, 43876, 43945, 44005, 44192, 44211, 44219, 44222, 44227, 44231, 44400

44246 (AD-A–206908/6/XAB) **Quantitative spectroscopy of x-ray laser plasmas in pulsed power. Annual progress report, April 1988-March 1989.** Maryland Univ., College Park, MD (USA). Lab. for Plasma and Fusion Energy Studies. Mar 1989. 3p. Available from NTIS, PC A02/MF A01.

At the start of the reporting period, the original Z -pinch setup was in place and running. Diagnostics consisting of a framing camera, 1 m N.I. VUV spectrometer, 1/2-m visible spectrometer and a Rogowski coil had been set up and were functional. To begin, with a framing camera a study of the visible signature of the plasma for a variety of different conditions (e.g., gas voltage in discharge, etc.) was conducted. This gave a working understanding of the gross behavior of the discharge. The emphasis was shifted to obtaining a temporal sequence of time-resolved photographic spectra which would include the 5f-3d and 4f-3d transitions in C IV, the lines of primary interest for this experiment. Preliminary steps, such as checking the calibration of the 1-m VUV spectrometer/MCP/photographic film with an Ar capillary discharge lamp, and the location of optimal discharge conditions/MCP pulse parameters/photographic film development procedures, were conducted.

44247 (AECL–8405) **Organic coolants and their applications to fusion reactors.** Gierszewski, P.; Hollies, B. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. Aug 1986. 69p. Order Number DE89634483/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Organic coolants offer a unique set of characteristics for fusion applications. Their advantages include high-temperature (670 K or 400 degrees C) but low-pressure (2 MPa) operation, limited reactivity with lithium and lithium-lead, reduced corrosion and activation, good heat-transfer capabilities, no magnetohydrodynamic (MHD) effects, and an operating temperature range that extends to room temperature. The major disadvantages are decomposition and flammability. However, organic coolants have been extensively studied in Canada, including nineteen years with an operating 60-MW organic-cooled reactor. Proper attention to design and coolant chemistry controlled these potential problems to acceptable levels. This experience provides an extensive data base for design under fusion conditions. The organic fluid characteristics are described in sufficient detail to allow fusion system designers to evaluate organic coolants for specific applications. To illustrate and assess the potential applications, analyses are presented for organic-cooled blankets, first walls, high heat flux components and thermal power cycles. Designs are identified that take advantage of organic coolant features, yet have fluid decomposition related costs that are a small fraction of the overall cost of electricity. For example, organic-cooled first walls make lithium/ferritic steel blankets possible in high-field, high-surface-heat-flux tokamaks, and organic-cooled limiters (up to about 8 MW/m^2 surface heating) are a safer alternative to water cooling for liquid metal blanket concept. Organics can also be used in intermediate heat exchanger loops to provide efficient heat transfer with low reactivity and a large tritium barrier. 55 refs.

44248 (AECL–9389) **Laser plasma beatwave accelerator experiment.** Ebrahim, N.A. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Mar 1987. 25p. Order Number DE89634492/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

An experiment to test the laser plasma beatware accelerator concept is outlined. A heuristic estimate of the relevant experimental parameters is obtained from fluid theory and considerations of wave-particle interactions. Acceleration of 10 MeV electrons to approximately 70 MeV over a plasma length of 3 cm appears to be feasible. This corresponds to an accelerating gradient of approximately 2.5 GeV/m.

44249 (AU/EE–051983) **High power krypton fluoride laser development for fusion energy research, annual report.** Offenberger, A.A.; McKen, D.C.D.; Fedosejevs, D.C.D.; Tomov, I.V. Alberta Univ., Edmonton, AB (Canada). Dept. of Electrical Engineering. 1982. 56p. (CE–02670). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This report describes progress achieved on a laser development program, the goal of which has been to establish a first generation short wavelength KrF laser facility capable of delivering nominally 20 J in 5 ns pulses for inertial confinement fusion research at irradiation intensity levels up to 5 x 10^{13} watts/cm^2. The KrF discharge laser front end is a subsystem utilizing a multi-etalon contolled master oscillator with 3 amplifiers. A portion of the output is used to laser trigger the high voltage switches on the A-amplifer, a second

portion to generate a pulse used for extraction of the A-amplifier and eventual pulse stacking, and a final portion to generate a Stokes shifted optical pulse in methane and for subsequent pulse in methane and for subsequent pulse shaping. The resulting pulse is used to seed the Raman compressor. Here the short seed pulse is counterpropagated with the stacked output of the A-amplifier in a final methane cell. By stimulated backward Raman scattering the energy from the A-amplifier is transferred to the short Stokes shifted seed pulse. The nominally 20 J, 5 ns output pulse will then be directed to the target chamber. A number of system up-grades have been incorporated, and a variety of issues related to front-end system performance have been studied, including beam polarization and temporal modulation effects, optical coatings and damage thresholds, dichroic mirrors, data acquisition and analysis. Fabrication, assembly and testing of the electron-beam pumped A-amplifier has been achieved during this year. This unit is the heart of the high energy laser output and so has received the greatest attention. Finally, extensive measurements have been made on Raman pulse generation and amplification. 21 figs., 33

44250 (CEA-CONF–9689) **Two-dimensional numerical simulations of laser irradiated targets.** Mucchielli, F.; Colin Verdiere, G. de; Galmiche, D. and others. CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France). 1988. 10p. (CONF-881015–: 12. international conference on plasma physics and controlled nuclear fusion research, Nice (France), 12-19 Oct 1988; IAEA-CN–50-B-4-8). Order Number DE89903177/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

We present numerical simulations of strongly two-dimensional laser experiments. First, it is concerned to restitute the direct driven implosion of microballoons irradiated with the two beams of Phebus laser facility at 0.53 μm wavelength and 3.2 TW power. In the second experiment, we study the impact between two foils. The accelerated foil is irradiated at 0,35 μm wavelength with a power of 20 GW. The numerical simulations are realized with the two - dimensional lagrangian FCI 2 code. The X-ray diagnostics are simulated with the DXFCI 2 code. In spite of numerical difficulties, principally close to the laser axis and the target interfaces, calculations have been carried out for a sufficient long time to provide results in accordance with the experiment. A simulation of the implosion of 600 μm in diameter microballoons made with an absorption rate of 40 % provides a neutron yield as well as X-ray emission peaks in agreement with the experiment. In the plane target case, it is shown that, for 80 μm in diameter focal spot, the 2D effects occurring in the acceleration of the foils influence in a preponderant way the energy transfer between these two foils.

44251 (CFFTP-B–86017) **Flux and energy dependence of methane production from graphite due to H^+ impact.** Davis, J.W.; Haasz, A.A.; Stangeby, P.C. Canadian Fusion Fuels Technology Project, Toronto, ON (Canada). Jun 1986. 17p. Order Number DE89634455/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Carbon is in widespread use for limiter surfaces, as well as first wall coatings in current tokamaks. Chemical erosion via methane formation, due to energetic H^+ impact, is expected to contribute to the total erosion rate of carbon from these surfaces. Experimental results are presented for the methane yield from pyrolytic graphite due to H^+ exposure, using a mass analyzed ion beam. H^+ energies of 0.1-3 keV and flux densities of $\sim 5x10^{13}$ to 10^{16} H^+/cm^2s were used. The measured methane yield (CH_4/H^+) initially increases with flux density, then reaches a maximum, which is followed by a gradual decrease. The magnitude of the maximum yield and the flux density at which it occurs depends on the graphite temperature. The yields obtained at temperatures corresponding to yield maxima at specific flux densities also show an initial increase, followed by a shallow maximum and a gradual decrease as a function of flux density; the maximum occurs at $\sim 10^{15}$ H^+/cm^2s. Also presented are results on the methane production dependence on ion energy over the range 0.1 to 3 keV, and graphite temperature dependence measurements.

44252 (CFFTP-B–86019) **Pyrolitic graphite: inherent h-content and trapping of sub-eV D^O atoms.** Beutler, R.; Haasz, A.A.; Stangeby, P.C. Canadian Fusion Fuels Technology Project, Toronto, ON (Canada). Jun 1986. 15p. Order Number DE89634494/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Inherent hydrogen concentrations in the near-surface region of pyrolytic graphite were measured, using Laser Release Analysis (involving laser-induced heating of the sample coupled with mass spectrometry for the analysis of released gases), for pyrolytic graphite previously baked in an UHV system at temperatures ranging from 500K to 2400K. After 24 hour bakeout at 500K, near-surface (~ 1 μm) hydrogen concentrations were measured to be $\sim 2x10^{16}$ - $4x10^{17}$ H/cm^2. These levels were reduced by 3-4 orders of magnitude following bakeout at 2200K-2400K. The effect of atmospheric exposure following bakeout on the near-surface H-concentration was investigated. Results are also presented on the deuterium uptake behaviour of pyrolytic graphite under sub-eV D^O exposure for various prior bakeout temperatures.

44253 (CFFTP-G–86040) **Tritium profiling in solids using the T(d, ^{4}He)n reaction.** Caterini, M.F. Canadian Fusion Fuels Technology Project, Toronto, ON (Canada). Mar 1986. 195p. Order Number DE89634456/JAW. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

The T(d, ^{4}He)n reaction provides a quantitative, non destructive technique for measuring the depth distribution of tritium in prospective first wall materials over depths to ~ 1 μm. Calculations have been undertaken to show how the depth resolution and detection sensitivity vary with experimental conditions. The best depth resolution is attained at an angle of incidence between 40 degrees and 60 degrees to the surface normal and an exit angle of 80 degrees to the surface normal. Results of calculations on the deuterium depth profiling technique using the D(^{3}He, ^{4}He)p reaction are shown for comparison. Assuming typical experimental conditions, for a silicon target a surface resolution of 0.03 μm is predicted, degrading to approximately 0.3 μm at a 1 μm depth. For a gold target, a resolution of 0.015 μm at the surface and 0.5 μm at a 0.5 μm depth is predicted. Experimental depth resolution curves have been obtained from a tritiated Ti thin film overlaid with gold films of various thicknesses. Misalignment of the deuteron beam with the target resulted in a systematic uncertainty in the profiling geometry. Accounting for this effect in the experimental calculations resulted in good agreement between theory and experiment. Also depth profiles have been obtained for a tritated Ti thin film and tritium implanted Si and graphite samples. Evidence suggests that sensitivities of 0.001 at.% can be attained.

44254 (EGG-FSP–8459) **Initial experimental investigation of the elemental volatility from steel alloys for fusion safety application.** Piet, S.J.; Neilson, R.M. Jr.; Smolik, G.R.; Reimann, G.A. EG and G Idaho, Inc., Idaho Falls, ID (USA). Apr 1989. 148p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE89016356/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

Oxidation-driven volatility tests for fusion steels are described and results analyzed. The combination of high temperatures and oxidizing conditions in fusion accidents could volatilize radiologically significant amounts of fusion structural radioactivity. Tests have been conducted in dry air with samples of the ferritic steel, HT-9, the nickel-based austenitic steel, PCA, and the manganese-based austenitic steel, AMCR-033. Some HT-9 tests, have been conducted in steam-argon mixtures, and some PCA tests have been conducted in ambient humidity air. Tests have generally been for 1, 5, or 20 h. Depending on the specific steel alloy, test temperatures have been 600, 800, 1000, 1200, 1300, and 1500°C (HT-9 only). The experimental program was originally intended only to determine the approximate level of severity of the problem and to identify the key elements. These questions have basically been answered for the steels. Oxidation-driven volatility must be considered to show that fusion safety accident objectives are met. Key elements in ferritic steels appear to be phosphorus and manganese isotopes. Key elements in austenitic steels appear to be manganese, iron, and molybdenum. Since there is currently inadequate knowledge to defend transport calculations, current accident assessments should not take credit for deposition within the confinement/containment building. On the other hand, the present volatility assessments do not include the possibility of mobilization (via spallation) of oxide

layers during transients. Future research should address these factors. 21 refs., 62 figs., 30 tabs.

44255 (EGG-M–89201) **Remarks for fusion power associates panel discussion: Fusion energy–The challenge and the vision.** Piet, S.J. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1 Jun 1989. 4p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-8906148–3: Fusion Power Associates annual meeting, Washington, DC (USA), 1-2 Jun 1989). Order Number DE89016217/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper briefly discusses the use of fusion energy as a viable future energy source. (LSP)

44256 (ENEA-RT-FUS–87-33) **Non-intuitive result in potential classical theory (toroidal magnetic field calculations).** Lo Surdo, C. ENEA, Frascati (Italy). Centro Ricerche Energia. Jul 1988. 19p. (In Italian). Order Number DE89761842/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

With regard to toroidal magnetic field calculations, this report proposes a solution to the problem: partial derivative with respect to X < partial derivative of Phi with respect to X >, where <> means average w.r.t. y over Omega identical to open domain of IR to the power of 2, normal w.r.t. the y axis, and Phi is the fundamental solution to the Poisson equation, del squared Phi = 2 Pi Rho in Omega, for given Rho. The result turns out to be a fairly non-intuitive one.

44257 (ENEA-RT-FUS–88-03) **Winding pack and ENEA conductor in central vault of the toroidal field coils of NET-22B: stress analysis.** Della Corte, A.; Cerreta, R. ENEA, Frascati (Italy). Centro Ricerche Energia. Jun 1988. 16p. Order Number DE89761964/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Presented at the ABAQUS users' conference (Providence, 1-3 June 1988).

In the present paper the results of the stress analysis of the toroidal field coil and of the ENEA conductor for the NET (Next European Torus: a European machine for research on controlled thermonuclear fusion) are presented. The calculations were performed with the FEM code ABAQUS. The main goals were: (1) to calculate the stress acting on all the components of the conductor; and (2) to study the influence on the stress distribution of the friction coefficient between case and winding pack. In the paper the obtained results are discussed. Some conclusions are reached: (a) the stainless steel jacket is subjected everywhere to an acceptable stress; (b) the stress applied to the epoxy insulation and equivalent winding pack material is often beyond elastic limits; and (c) the friction coefficient plays a very important role.

44258 (ENEA-RT-FUS–88-08) **Tritium cycle of compact high-field tokamaks. Frascati (Italy) tokamak upgrade status report, November 1987.** Roccella, M.; Bonizzoni, G.; Chiesa, P.; Ghezzi, F.; Nassi, M.; Pavesi, U.; Amedeo, P.; Boschetti, G.; Giffanti, F.; Moriggio, A. ENEA, Frascati (Italy). Centro Ricerche Energia. Nov 1988. 62p. (In Italian). Order Number DE89761970/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Contract ENEA-CNR 2202, Series 3.

Some theoretical results and the current status of the work on a prototype plant for the tritium cycle of compact high-field tokamaks (such as, Ignitor, CIT, etc.), using the SAES Getter St 707 getter material, are described in this report. The schematics and present status of the main subplants of the cycle are reported together with some experimental results demonstrating the possibility of utilizing the St 707 material to purify the inert atmosphere of the glove-boxes and the secondary containment of the double-containment metal canalization which is to eventually house the various parts of the plant. Finally, as an example, the FTU machine, under construction at ENEA Frascati, is taken as reference, and theoretical evaluations are given for the inventory, permeation and release of the tritium from the first wall and the thermal shields of such a tokamak.

44259 (GA-A–19536) **DIII-D Research Operations: Final report, November 1, 1983–October 31, 1988.** General Atomics Co., San Diego, CA (USA). May 1989. 169p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-84ER51044. Order Number DE89013999/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This report summarizes Research Operations on the Doublet III and DIII-D tokamaks for the contract period November 1, 1983 to October 31, 1988. The General Atomics tokamak research program has strived to advance the understanding and bounds of tokamak physics. Research at General Atomics has emphasized plasma shaping and high beta operations. The expanded boundary divertor that was invented in Doublet III was capitalized on in the design of the DIII-D device. The DIII-D tokamak quickly demonstrated these high beta and enhanced confinement features of non-circular divertor geometry that have been adapted in next generation tokamak designs such as CIT and ITER. Particular topics discussed are: confinement; beta and stability; boundary physics; rf heating; current drive; diagnostics; vessel modification (FY84–FY85); commissioning of DIII-D (FY86); hardware development (FY87–FY88); FY88 operations; collaborative programs; quality assurance; planning and control; computer operations; and safety.

44260 (GA-A–19687) **DIII-D safety procedures and operational experience.** Petersen, P.I.; Savercool, R.L.; Taylor, P.L. General Atomics, San Diego, CA (USA). Jun 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-89ER51114. (CONF-8904159–4: International Atomic Energy Agency fusion reactor safety meeting, Jackson, WY (USA), 4-7 Apr 1989). Order Number DE89015966/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The DIII-D research tokamak, which has near reactor dimensions, has been operating for approximately ten years. The hazards at the facility include high voltages, high currents, cryogenics, radiation, and normal industrial hazards. Procedures have been developed for operating the device, minimizing both the hazards to personnel and the damage caused by equipment failures, and for logging of failures. The machine and the neutral beamlines have been operated in hydrogen and are now starting operation in deuterium to expand the machine capabilities to reactor relevant regimes. Deuterium operation creates a significant amount of neutrons and therefore a neutron shield is being built around the machine area to reduce personnel radiation to As Low As Reasonably Achievable (ALARA) and to keep radiation at the site boundary at or below a limit of 20 mrem per calendar year. Gamma radiation shielding walls have been in place since the initial machine construction. The safety procedures for the DIII-D facility will be outlined and the accident experience will be discussed together with the neutron radiation monitoring program being developed. 4 figs., 3 tabs.

44261 (GA-A–19693) **Helium glow wall conditioning of the DIII-D tokamak with large area graphite coverage.** Jackson, G.L.; Taylor, T.S.; Petersen, P.I.; Taylor, P.L. General Atomics, San Diego, CA (USA). May 1989. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-89ER51114. (CONF-8904230–3: AVS topical conference on surface conditioning of vacuum systems, Los Angeles, CA (USA), 3-7 Apr 1989). Order Number DE89015216/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Helium glow wall conditioning (HeGWC) is the primary technique for conditioning the DIII-D walls which are composed of Inconel and graphite. Presently, 40% (31 m^2) of the DIII-D plasma facing surfaces consist of graphite tiles covering the inside, top, and bottom DIII-D walls which are the high heat flux surfaces for divertor and inside wall limiter discharges. HeGWC with $T_{wall} \leq 50°C$ is effective both in removing low Z impurities and desorbing hydrogenic particles from this large graphite "reservoir." The effective desorption of hydrogen species from the graphite has led to lower recycling and improved particle control during tokamak discharges. We will first discuss the DIII-D glow discharge apparatus, the characterization of the glow discharge, the dependence of particle removal rates on the glow parameters, particularly electrode voltage and the duration of the glow session, and the subsequent discharge particle balance. After installation of graphite tiles covering 40% of the first wall (prior coverage was 9%, primarily in the lower divertor region), previously successful discharge cleaning and wall conditioning techniques in hydrogen failed to give reproducible high-quality discharges. With HeGWC, H-mode discharges were again reproducibly obtained. The main advantages of HeGWC during this phase of initial conditioning

were: disruption recovery during tokamak operations by removal of impurities such as CO, and reduced fueling from the walls, allowing reproducible burnthrough and plasma density control. 13 refs., 6 figs.

44262 (IAE–4692/7) **Principles for construction and structure of the control system for the T-15 tokamak complex.** Tilinin, G.N.; Stavisskij, B.A.; Strelkov, V.S.; Ploskirev, G.N.; Shchedrov, V.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1988. 28p. (In Russian). Order Number DE89632035/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Main principles for construction of the T-15 control system are reported. The operating conditions for tokamak and its engineering systems are described, duties and functions of technological function operators are specified. Ideas on the needed level of automation of control subsystems for technological systems and T-15 control system are presented. Functions for T-15 shift supervisor and its interrelations with technological system operators and a leading experimenter are determined in detail. 10 tabs.

44263 (IAEA-TECDOC–495) **Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.** International Atomic Energy Agency, Vienna (Austria). Feb 1989. 346p. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Descriptions of operation and maintenance of current tokamaks (TFTR, JET, JT-60) is discussed in the context of radioactivation resulting from thermonuclear reactions. Plans for future devices (NET, CIT, FGR) with respect to remote handling, maintenance, measurements, and robotics are discussed. Refs, figs and tabs.

44264 (IAEA-TECDOC–495, pp. 95-102) **CEA contribution to advanced robotics.** Rouyer, J.L. (CEA, 92 - Fontenay-aux-Roses (France). Unite de Genie Robotique Avance). International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Due to development of nuclear energy in France, CEA has a long experience in nuclear robotics. It started from remote handling in hot cells and extended to inspections in nuclear reactors, intervention with vehicles, decommissioning of experimental plants, maintenance and intervention in reactors and reprocessing plants. Existing equipments, which are briefly described, show present status of performances for these applications. Research activities are going-on to develop this potential. Main aspects of recent advances in nuclear robotics are detailed to show that each application has some relevance with fusion remote handling needs. In this panel of activities, fusion would profit more directly from reprocessing and reactor maintenance studies, Computer Aided Teleoperation and advanced manipulators developments. But all the projects in nuclear and servicing robotics may have spin-offs for fusion and mention to Eureka projects will underline the necessity for European cooperation in this field. Finally, honor will be rendered to Jean Vertut who had from the first moment a real passion for fusion. (author). 3 refs, 4 figs, 2 tabs.

44265 (IAEA-TECDOC–495, pp. 11-23) **Maintenance concept for the TFTR.** Little, R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

This paper provides an overview of the Tokamak Fusion Test Reactor (TFTR) plans for operation in the deuterium-tritium phase. The emphasis is on the engineering aspects of the plan and the integration of maintenance activities into the overall experimental program. The specific approaches taken by TFTR in shielding and manipulators are outlined. An attempt is made to point out the complexities inherent in the present generation of tokamak research when nuclear aspects become an additional feature. (author). 4 refs, 8 figs, 3 tabs.

44266 (IAEA-TECDOC–495, pp. 25-34) **Remote maintenance concepts for the compact ignition tokamak.** Davis, F.C. (Oak Ridge National Lab., TN (USA)); Hager, E.R. International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Because deuterium-tritium fuel will be used in the Compact Ignition Tokamak (CIT), remote handling technology is needed to carry out some maintenance operations on the machine. In keeping with the compact, low-cost nature of CIT, remote maintenance is provided only for systems with the highest probability of failure. Remote operations include removing, repairing (if feasible), and replacing such components as thermal protection tiles on the first wall, radio-frequency (rf) heating modules, and diagnostic modules. For maintenance inside the vacuum vessel, major pieces of equipment under development include an articulated boom manipulator with servomanipulators, an inspection manipulator, and special tooling. For maintenance outside the cryostat, remote equipment includes a bridge-mounted manipulator system, equipment for decontamination and hot cell activities, and for handling and packaging solid radioactive waste. The conceptual design phase of the CIT project is nearing completion; research and development activities in support of the project include demonstrations of remote maintenance operations on full-size partial mock-ups. (author). 9 figs.

44267 (IAEA-TECDOC–495, pp. 103-111) **Highlights of the technical status of nuclear robotics in Japan.** Shinohara, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)); Tachikawa, K. International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Research and development activities on advanced robotic remote system technologies for nuclear applications have been accelerated in Japan since 1980. In the development project of automated surveillance systems carried out from 1980 through 1984, two types of remotely operated mobile systems, mono-rail type and crawler type, were developed. In the field of reactor decommissioning technology development started in 1981, light-duty and heavy-duty amphibious robots for reactor dismantling work has been developed. The project of advanced robotics technology started in 1983 includes a program for nuclear application in which a four-legged walking robot is being developed. Basic research on intelligent robotic system technology for nuclear application is included in the new long term national program of nuclear energy development authorized recently by the Atomic Energy Commission. The R and D program of remote technology for fusion reactor maintenance has recently been studied and proposed. This program includes the development of robotic remote systems to be used in a highly radioactive vacuum vessel. (author). 8 refs, 6 figs.

44268 (IAEA-TECDOC–495, pp. 115-127) **Use of teleoperators and transporters in JET.** Raimondi, T. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking); Galbiati, L.; Jones, L.P.D.F. International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number

DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The teleoperator for dexterous tasks is the Mascot IV force-feedback servomanipulator, consisting of a two-armed master unit and a kinematically similar slave. A load capacity of 20 kg, a sensitivity of 150 g, low inertia and good stiffness are among the main features. A microprocessor-based digital control system allows serial link and computer-aided teleoperation, teach-repeat, weight compensation and trajectory constraints. Typical tasks for the manipulator are leak detection, repair welding, bolting, insertion of connectors, positioning of mating parts, heating jackets and special tools, such as the lip cutting/welding trolleys and the orbital pipe welders and cutters. The manipulator can be positioned in the vessel by an articulated boom with five vertical hinges and a pan/tilt/roll end fixture. The boom enters the vessel through a port with small clearances situated on the equatorial plane and reaches round to the opposite side of the torus. To handle heavy components (antennae and limiters), the manipulator is replaced by special end-effectors. By controlling the accelerations to limit oscillations, it is possible to position a 350 kg payload at 10 m from the first hinge with 1 mm accuracy. The control modes, using a microprocessor-based system, are teach-repeat, joint-by-joint or resolved motion. Viewing is provided by two mono TV cameras mounted on articulated arms pre-programmed and in future, self-tracking to obtain direct and side views for depth perception. Outside the vessel, the main transporter will be a bridge-mounted telescopic boom at present being built by Noell to JET specifications, supplemented by the roving turret truck and low-level transporter. (author). 1 ref., 14 figs.

44269 (IAEA-TECDOC–495, pp. 129-140) **TFTR maintenance manipulator.** Selig, M. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Ingenieurtechnik); Boehme, G.; Kungl, D.; Loesser, D.; Heitzenroeder, P.; Cerdan, G. International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

TFTR plans to begin D-T experiments in early 1990. The D-T experimental program will produce a hundred shots, with a neutron generation rate of 10^{19} neutrons per shot. This will result in high levels of neutron activation in TFTR, especially in the vacuum torus. The primary purpose of the Maintenance Manipulator is to provide a means of remotely performing certain defined maintenance and inspection tasks inside the vacuum torus so as to minimize exposure of personnel to radiation. The Manipulator consists of a six-link folding boom connected to a fixed boom on a movable carriage. The entire Manipulator is housed in a vacuum antechamber connecting to the vacuum torus. Through a port formerly used for a vacuum pumping duct, the boom extends 180 degrees in either direction to provide complete coverage of the torus. The four 3500 liter/second turbopumps which were formerly used on the pumping duct will be mounted on the antechamber. The Manipulator will utilize two end effectors. The first, called a General Inspection Arm provides a moveable platform for an inspection camera and an in-vacuum leak detector. The second is a bilateral, force-reflecting pair of slave arms which utilize specially developed tools to perform several maintenance functions. All components except the slave arms are capable of operating TFTR's vacuum environment and during 150 deg. C bakeout of the torus. (author). 6 refs, 11 figs.

44270 (IAEA-TECDOC–495, pp. 151-161) **Vehicle concept for NET in-vessel inspection and maintenance.** Maisonnier, D. (CEA, 92 - Fonteney-aux-Roses (France). Unite de Genie Robotique Avance). International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

When considering the problem of large tokamak machines in-vessel remote maintenance, an articulated boom concept is today a favourite choice mainly because of the large experience gathered in JET and TFTR. This concept suffers however from two major drawbacks because of its cantilever design and the large dimensions and masses of its articulated links: a rather "floppish" structure, which causes problems during heavy components pick-up; and an inaccurate trajectory control, which practically imposes very slow boom movements inside the toroidal vessel. Within the frame of the NET Technology Programs, CEA-UGRA has undertaken the development of an alternative concept. The aim was to propose a vehicle-based design which, because of the much smaller size of the end-effector carrier (the vehicle) onto a fixed rail (installed before each intervention), would overcome these difficulties. Although it is too early to assess the full potential of the proposed design, it is worth stressing that the two reasons which usually render a vehicle concept unacceptable - i.e. rails supports inside the vessel and cable management - have been extensively analysed and that the proposed solution appear satisfactory. Should this be confirmed by the forthcoming engineering design phase, the proposed vehicle will be a very attractive device for NET in-vessel interventions. (author). 11 refs, 10 figs.

44271 (IAEA-TECDOC–495, pp. 163-187) **Electric master-slave manipulators for remote maintenance in fusion plants.** Koehler, G.W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Ingenieurtechnik); Huebener, J.; Salaske, M. International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Maintenance work in fusion plants such as the Next European Torus (NET) call for mobile high performance general-purpose remote handling devices. This requirement can be fulfilled best by electric master-slave manipulators. The development of types conforming to the particular boundary conditions in fusion plants could be based on type EMSM 2-B conceived and built in the Federal Republic of Germany, and on the presently developed EMSM-WA for maintenance work in nuclear fuel reprocessing plants. The first type needed is for a NET in-vessel handling unit. It is envisaged for use as a double-arm manipulator unit and as a supplement to the necessary divertor plate handling unit. Since operations involving very diverse requirements in terms of loading and degrees of difficulty will have to be effected in the NET facility, an EMSM family has been conceived which consists of electric master-slave manipulators with four different handling capacities and several variants. (author). 11 refs, 22 figs, 1 tab.

44272 (IAEA-TECDOC–495, pp. 261-271) **Dynamic simulation for the study of remote handling operations.** Trudel, C.P.R. (Spar Aerospace Ltd., Toronto, ON (Canada)); Fung, P.T.K.; Rakhsha, F. International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The inspection, maintenance and repair of fusion machines will require the extensive use of remote handling equipment to minimise the human exposure to the high radiation environment. A high fidelity simulation can be a very valuable tool to assist in the manipulator design, operations, trajectory planning, parameter optimisation and system verification. ASAD, a non-real time simulation program developed by Spar Aerospace, through funding from the National Research Council of Canada, is used to simulate the remote manipulator on the US Space Shuttle program. This simulation program is now being adapted to simulate a wide range of terrestrial manipulator configurations, most notably the In-Vessel Handling Unit (IVHU) for the Next European Torus (NET) program. This terrestrial version ASAD-T, is capable of simulating a manipulator consisting of up to 7 joints, and includes models of the flexible dynamics of the drive system and the structure, as well as the details of the control algorithms at the manipulator level and at the joint level. A modular

approach has been used such that a variety of manipulators and control systems can be simulated by module substitution. Extensive use of parametric data to describe the manipulator and control system permits the modelling of a wide variety of manipulator configurations. The simulation, as configured for the Space Shuttle Remote Manipulator System, has undergone an extensive validation process against other simulations, test data and actual flight data. This paper describes the capabilities and underlying assumptions of the simulation program ASAD-T, along with a brief description of the simulation development of an in-vessel manipulator for fusion reactors now in progress. (author). 4 refs, 8 figs.

44273 (IAEA-TECDOC–495, pp. 275-284) **Viewing systems for NET and TFTR.** Cerdan, G. (CEA, 92 - Fontenay-aux-Roses (France). Unite de Genie Robotique Avance); Maisonnier, D. International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Very hostile environmental conditions are expected inside the NET (Next European Torus) and TFTR (Test Fusion Tokamak Reactor) vacuum vessels because of the machine structures activation by high energy neutrons. Remote viewing systems will therefore be required to perform a number of functions which will be essential for the identification, location and realization of most remote maintenance operations. This paper presents the CEA-UGRA recommendations for the NET viewing systems, NET Vessel Inspection System and NET Detailed Observation System, and a description of the viewing system which has been installed onto the TFTR Maintenance Manipulator. (author). 9 figs, 1 tab.

44274 (IAEA-TECDOC–495, pp. 285-301) **Electromagnetic and optical proximity sensors for in-vessel handling unit control.** Decreton, M. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)); Massaut, V.; Mortier, F. du. International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The problems of collision protection and accurate positioning of the in-vessel handling unit of a fusion reactor are studied. It essentially concentrates on different sensing techniques capable to withstand the hostile environment foreseen for the maintenance work during the reactor shut down periods. After analysing the needs of hardware collision protection system, and situating the role of accurate proximity in the overall control system of the unit, a certain number of specific types of sensors are scanned. Their functionality, as well as their hardening to the environmental conditions are discussed. (author). 19 figs.

44275 (IAEA-TECDOC–495, pp. 201-213) **Integration, control and operation of JET remote handling equipment.** Rolfe, A.C. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

This paper describes and discusses the interconnection, control and operation of the JET Remote Handling equipment comprising transporters, such as the articulated boom, end-effectors, such as the Mascot servo-manipulator, various welding, cutting and handling tools and the extensive CCTV viewing system. The focal point of the JET Remote Maintenance System (RMS) is the Remote Handling Control Room (RHCR) from which all RH equipment is monitored and controlled; this contains five general purpose RH Work Stations (RHWS), two real-time 3D Graphic Work Stations (GWS) and two Servo-Manipulator Master Stations (SMMS). The paper describes and discusses the design and use of the RHCR and its equipment highlighting those areas of particular importance for the Man-Machine Interface (MMI). The RMS comprises a 3-level hierarchical structure, consisting of the RH equipment Local Control Units (LCU), an interconnection system and a supervising minicomputer which provides an adaptable MMI. The RH equipment LCU's vary in type from simple discrete switching systems to multiprocessor intelligent controllers. The paper describes and discusses some of the more recent LCU's in use at JET. The interconnection system comprises a number of point-to-point serial links and two Local Area Networks (CAMAC and Ethernet). This architecture was adopted in order to fulfill the RH requirements whilst using as much JET standard CODAS equipment as possible to minimise development and maintenance costs. The control and operation of any piece of RH equipment is dictated by the LCU functions, the task and the MMI. (author). 8 refs, 9 figs.

44276 (IAEA-TECDOC–495, pp. 215-226) **Remote handling control with graphical man-machine interface for NET and JET.** Leinemann, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung); Kuehnapfel, U.; Ludwig, A. International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

For fusion plants fully remote maintenance concepts are favoured for costs as well as for safety and availability reasons. The remote work in a geometrical complex environment with kinematical redundant manipulators calls for computer support. Hence a control system concept was worked out, which organizes a close, problem-suited cooperation of man and machine (computer), based on mutual surveillance and mutual help to get a maximum in safety of work and speed of operation. The system provides two modes of operation. In the automatic mode, the operator initiates and supervises autonomously working, pre-programmed subtasks (e.g. transportation with the boom). Interruptions and corrections by the operator are possible. In the manual mode of operation, the operator is working directly in the motion control loop, using different masters for various end-effectors. In this mode the operator has the full control, but he may be supported by so called handling support modules like for example coordinate transformations, resolved motion algorithms, collision control, or special positioning tools. The central module of the control system is a geometric/kinematic real-time simulator. This simulator serves for planning and off-line programming of maintenance sequences, and, in the execution phase, for synthetic scene presentation. In the latter case the simulator is controlled by the joint angle signals of the manipulator. It provides the operator with views not obtainable by TV-systems because of the restrictive possibilities of camera positioning, supplementing standard TV-systems which are indispensable for manually done contact work. A first implementation of a real-time simulator and its integration in an overall control system was done for JET. This system simulates the in-vessel handling with the JET-boom and its various end-effectors. An important problem in the area of simulation is the generation of model data.

44277 (IAEA-TECDOC–495, pp. 227-234) **Control system for the TFTR maintenance manipulator.** Mueller, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Ingenieurtechnik); Hinz, A.; Menzel, U. International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

A simple, low-cost and easy-to-operate control system is being developed by Kernforschungszentrum Karlsruhe (KfK) for the TFTR-Maintenance Manipulator (MM) for the Tokamak Fusion Test Reactor (TFTR) at the Princeton Plasma Physics Laboratory in

Princeton, N.J. (USA). High temperature stepper motors are used for the drives. Special incremental encoders attached to the second shaft end of the motors were designed for positioning purposes. The positioning principle is based on generating and counting electrical pulses. PTP and path control is provided. Deployment path determination was made utilizing CAD-generated drawings. Teach-in and playback possibilities are provided. (author). 1 ref., 6 figs.

44278 (IAEA-TECDOC–495, pp. 235-248) **Control system supporting different modes of telemanipulator operation for in-vessel handling.** Breitwieser, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Datenverarbeitung in der Technik). International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Fast maintenance capabilities of an IVHU system are of great importance in fusion plant operation. One key element is a set of work units. Some are specialized to certain handling tasks and some are of the kind of telemanipulators suited for more general purpose application. Different operation modes based on a microcomputer control system are described. Emphasis is put on the implementation of a control system by KfK-IDT using an EMSM-2 type servo master slave manipulator. Several classes of operation modes are distinguished ranging from complete manual to complete automatic modes. (author). 6 refs, 11 figs.

44279 (IAEA-TECDOC–495, pp. 325-337) **Application of SMAs to pipe connections, mechanical connections, vacuum seals and jack systems.** Kondoh, M. (Toshiba Corp., Tokyo (Japan). Fusion Technology Development Office); Uchida, T.; Iida, H. International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The simplification of maintenance procedures for reactor structures is one of the important items for operating D-T fusion reactors. Remote maintenance applications using shape memory alloys (SMA) for fusion reactors is proposed and their feasibility discussed. Four types of SMA components have been fabricated and tested: pipe connector for primary coolant lines instead of welding/cutting, C-shaped mechanical quick connectors for segment connections instead of bolting, metal packing for vacuum seals instead of lip seal welding or metal O-rings, and jack systems for lifting heavy reactor components. For the pipe connectors, a flange-type was tested. A flange-type connector consists of two pipe flanges (SUS304, diameter 200) and twelve Ni-Ti SMA bolts (M6Xl50). A helium leak of less than $1x10^{-7}$ Pacenter dotl/s was not detected. For the C-shaped connectors, a pair of interlocking C-shaped plates is connected by eight Ni-Ti bolts (M8Xl84) and the SMA bolt recovery force is used as the connector force. A force of $4x10^{4}$N was obtained at 0.86% of the given strain. The metal packing is made by bonding SMA wire to an O-ring. A welding test of the SMA was done. Two SMA rods of 8 mm in dia. were bonded by CO_2 laser welding. The shape memory effect was not lost after welding. The jack systems consist of two oblique keys connected by SMA bolts (M9Xl260). A lifting force of $2.7x10^{4}$N was obtained at 1.9% of the given strain. From the results of these experiments, it was found that applications using SMAs, especially Ni-Ti alloys, is feasible for fusion reactors. (author). 7 refs, figs.

44280 (IAEA-TECDOC–495, pp. 303-310) **GMS - A high-precision geometry measurement system for large fusion reactor components.** Koehler, B. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

For the remote maintenance of fusion machines a surveying system will be needed for measuring the geometry of components outside (ex-vessel) as well as inside the vacuum-vessel (in-vessel). A study of principally applicable techniques indicated that the triangulation with theodolites is well suited for the ex-vessel surveying. The remote-controlled and CAD-supported surveying system GMS (Geometry Measurement System), developed by KfK, is equipped with two digital theodolites, a laser- and a camera-theodolite, completely controlled by a computer. The data transfer CAD-GMS will be realized with the standardized IGES-interface. To show the feasibility for the ex-vessel surveying a GMS-prototype, equipped with a single laser-theodolite, is built up presently. The investigations for the in-vessel surveying have been started and first design concepts for such equipment are outlined. (author). 9 refs, 5 figs.

44281 (IAEA-TECDOC–495, pp. 311-324) **Development of connection techniques for fusion devices.** Selig, M. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Ingenieurtechnik); Gumb, L. International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The Nuclear Research Center of Karlsruhe (KFK) has developed remote handling equipment for post irradiation examination hot cells, radwaste handling facilities and various other nuclear applications for a period of more than twenty-five years, but since a growing portion of the KFK R and D program has been devoted to fusion technology in recent years, KFK has established also a development program on remotely operated connection techniques for fusion devices. In order to get detailed information about the latest status a retroperspective literature research has been initiated at the beginning of the work. The result of this investigation was a variety of pipe connecting and pipe welding systems which were compared and evaluated. Another objective of the study was the comparison of welding and cutting techniques as an alternative solution for joining pipes and vacuum ducts. The results elaborated in the study show that there is no method or technique available which meets the requirement for fusion devices. Therefore an extensive R and D program has been proposed. The R and D program has been started with the investigation of pipe connectors for water cooling liquid metal breeder fuelling, gas cooling and gas purging systems, electrical connectors, and cutting and welding techniques for fusion reactors. Additional efforts have been going into the performance of tightness tests under normal and elevated stress conditions with selected pipe connectors, and in the investigation of a test rig for integral test of the connecting technique under NET typical geometrical conditions and with NET typical handling tools. The test facility will simulate the upper part of a prototype blanket segmentation including its auxiliary coolant make up and supply system. (author). 4 refs, 15 figs.

44282 (INIS-mf–11496) **Neutron energy spectrum in graphite blankets of fusion reactors. Measurements and calculations.** Tsechanski, A. Ben-Gurion Univ. of the Negev, Beersheba (Israel). Sep 1981. 122p. (In Hebrew). Order Number DE89634457/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

Neutron flux measurements were performed in a graphite stack and compared with calculations made with a two dimensional transport computer code. In the present work it is observed that the calculated spectrum in the elastic and inelastic scattering ranges (the first collision range in both cases), is sensitive to details of the angular distribution of these neutrons. Regarding the discrepancies in the elastic scattering range it is concluded that the microscopic cross section library ENDF/B-IV overestimates the large angle scattering (back scattering) as can be seen from comparison of measured and calculated spectra. The two most important conclusions of the present work are: 1. Inelastic scattering interaction of D-T neutrons in graphite cannot be calculated without a proper account of energy-angle correlation. 2. An experimental setup

supplying monoenergetic collimated D-T neutrons constitutes a sensitive although indirect means for measuring angular distributions in inelastic and elastic scattering. 49 refs.

44283 (INIS-mf–11500) **Interactions of D-T neutrons in graphite and lithium blankets of fusion reactors. Measurements and calculations.** Ofek, R. Ben-Gurion Univ. of the Negev, Beersheba (Israel). May 1986. 169p. (In Hebrew). Order Number DE89632031/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The present study deals with integral experiment and calculation of neutron energy spectra in bulks of graphite which is used as a reflector in blankets of fusion reactors, and lithium, the material of the blanket on which lithium is bred due to neutron interactions. The collimated beam configuration enables - due to the almost monoenergeticity and unidirectionality of the neutrons impinging on the target - to identify fine details in the measured spectra, and also facilitates the absolute normalization of the spectra. The measured and calculated spectra are generally in a good agreement and in a very good agreement at mesh points close to the system axis. A few conclusions may be drawn: (a) the collimated beam source configuration is a sensitive tool for measuring neutron energy spectra with a high resolution, (b) the method of unfolding proton-recoil spectra measured with a NE-213 scintillator should be improved, (c) MCNP and DOT 4.2 may be used as complementary codes for neutron transport calculations of fusion blankets and deep-penetration problems, (d) the updating of the cross-section libraries and checking by integral experiments is highly important for the design of fusion blankets. The present study may be regarded as an important course in the research and development of tools for the design of fusion blankets. 126 refs.

44284 (INIS-mf–11503, pp. 1-2) **Solar pumped lasers. From fission to fusion.** Oron, M. (Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center). Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Summary only.

44285 (INIS-SU–109/A, pp. 40-42) **On the efficiency of target acceleration in pulsed thermonuclear devices based on heavy ion beams.** Afanas'ev, Yu.V.; Isakov, V.A.; Kachiyan, K.A. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics.* Order Number DE89012198/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 10.

The paper deals with derivation of the law of motion of tamper-absorber boundary in the case of heterogeneous energy release as well as with evaluation of the effect of proposal about immobility of this boundary on the choice of target structure. It is shown that at any degree of energy release heterogeneity the maximal hydrodynamic efficiency of multilayer target acceleration by heavy ion beams is achieved when tamper-absorber boundary is stable during the period of ion beam action. 3 refs.; 1 fig.

44286 (IPPCZ–280) **On optimization of the multijunction grill for the lower hybrid current drive.** Preinhaelter, J. Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Ustav Fyziky Plazmatu. Apr 1988. 35p. Order Number DE89634490/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The design of a multijunction grill which is supposed to be used in current drive experiments, calls for the optimization over three most important parameters: the phase shift ΔPHI among the adjacent waveguides, the length of the multijunction grill L_g (from the junction to the mouth) and the surface density n_0. This was demonstrated by the results of a numerical investigation of the four-waveguide grill designed for a small tokamak. It was shown that current drive efficiency (or the directivity) can reach 50% for practically arbitrary ΔPHI (not =0deg, 180deg), if L_g is dosen adequately. Enhanced current drive efficiency at ΔPHInot =90deg follows from an unevenly distributed power among separate waveguides and from the self-adaptive adjustment of the phases of the incident waves. The risk of power overload of the waveguides grows with decreasing n_0. A brief description of the author's variant of the theory of wave diffraction on the junction is given in the Appendix. (author). 13 figs., 17 refs.

44287 (IPPCZ–283) **Effect of the length of the multijunction grill on its lower hybrid current drive efficiency.** Preinhaelter, J. Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Ustav Fyziky Plazmatu. Jun 1988. 43p. Order Number DE89634491/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A slow wave structure known as a multijunction grill is often used in lower hybrid current drive and plasma heating experiments in tokamaks. The distance between the junction of subsidiary waveguides in the main line and the grill mouth is one of the most important grill parameters determining the spectrum of radiated waves, the total reflection coefficient, power distribution among waveguides and the actual phase shift of individual waves. For maximum lower hybrid current drive efficiency, the grill must also be optimized with respect to this parameter. The optimization procedure is shown by using the results of a numerical investigation of the four-waveguide multijunction grill operated in small tokamak CASTOR. (J.U.). 5 figs., 9 refs.

44288 (JAERI-M–89-038) **Observation of H-mode by edge heating solely by electron cyclotron heating in a divertor configuration of JFT-2M tokamak.** Hoshino, Katsumichi; Yamamoto, Takumi; Kawashima, Hisato and others. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1989. 10p. Order Number DE89906475/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

H-mode is observed by the edge heating of the JFT-2M plasma solely by the electron cyclotron heating (ECH). The threshold power for the H-mode transition is as low as 120 kW, which is the least threshold power observed in the JFT-2M tokamak. It is surprising that complete edge electron heating can produce the H-mode with such a small ECH power without the additional heating power at the plasma core. This result clearly shows that the H-mode mechanism lies at the very edge (near the separatrix) of the tokamak plasma in the divertor configuration. (author).

44289 (KFK–4567) **Thermodynamics of ceramic breeder materials for fusion reactors.** Goetzmann, O. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion. May 1989. 41p. Order Number DE89796042/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Based on known or deduced phase relationships in ternary lithium oxygen systems such as Li-Al-O, Li-Si-O and Li-Zr-O, the unknown free enthalpy of formation values of ternary compounds are calculated starting from the known data of the compounds of the binary border systems. Criterion for the data assessment is interconsistency of the data of all the compounds within a given multi-component system. With the help of these data the development of partial pressures during the breeding process can be calculated for all the compounds of interest. In order to facilitate a compatibility assessment the quaternary systems Cr-Li-Si-O, Fe-Li-Si-O and Be-Li-Si-O were also investigated and thermodynamic data of pertinent ternary and quaternary compounds determined. Both the partial pressure development and the compatibility behaviour of a lithium containing compound are criteria for its qualification as a breeder material for a fusion reactor. (orig.).

44290 (RAL–89-037) **Supra-ballistic phonons.** Russell, F.M. Rutherford Appleton Lab., Chilton (UK). May 1989. 9p. Order Number DE89634434/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Energetic particles moving with a solid, either from nuclear reactions or externally injected, deposit energy by inelastic scattering processes which eventually appears as thermal energy. If the transfer of energy occurs in a crystalline solid then it is possible to couple some of the energy directly to the nuclei forming the lattice by generating phonons. In this paper the transfer of energy from a compound excited nucleus to the lattice is examined by introducing a virtual particle PI. It is shown that by including a PI in the nuclear reaction a substantial amount of energy can be coupled directly to the lattice. In the lattice this particle behaves as a spatially localized

phonon of high energy, the so-called supra-ballistic phonon. By multiple inelastic scattering the supra-ballistic phonon eventually thermalizes. Because both the virtual particle PI and the equivalent supra-ballistic phonon have no charge or spin and can only exist within a lattice it is difficult to detect other than by its decay into thermal phonons. The possibility of a PI removing excess energy from a compound nucleus formed by the cold fusion of deuterium is examined. (Author).

44291 (UCRL–52000-88-10, pp. 1-8) **Neutron penumbral imaging of laser-fusion targets.** Lerche, R.A.; Ress, D.B. Lawrence Livermore National Lab., CA (USA). Oct 1988. In *Energy and technology review.* Order Number DE89005308/JAW. Available from NTIS, PC A03/MF A01.

Using a new technique, penumbral coded-aperture imaging, the first neutron images of laser-driven, inertial-confinement fusion targets were obtained. With these images the deuterium-tritium burn region within a compressed target can be measured directly. 4 references, 11 figures.

44292 (UCRL–100013) **Modeling flashlamp-pumped ND:glass disk amplifiers.** Jancaitis, K.S.; Erlandson, A.C.; Murray, J.E.; Powell, H.T.; Trenholme, J.B. Lawrence Livermore National Lab., CA (USA). 2 Jun 1989. 18p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890423–13-Vugraphs: CLEO '89: conference on lasers and electro optics, Baltimore, MD (USA), 24-28 Apr 1989). Order Number DE89016635/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have developed a semi-empirical model for Nd:glass disk amplifiers, parameterized in terms of the flashlamp output power, which substantially reduces the amount of experimental data required to fully characterize the amplifier performance. 3 refs.

44293 (UCRL–100358-Rev.1) **Commercial high current ignitron development: Revision 1.** Kihara, R.; Cummings, D.B.; Leighton, K.S.; Shulski, A.P. Lawrence Livermore National Lab., CA (USA). Jun 1989. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890665–36-Rev.1: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, CA (USA), 12-14 Jun 1989). Order Number DE89016650/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Our overall goal is to develop and qualify devices capable of repetitively switching high peak currents (>1 MA) and large quantities of charge (>500 C). In 1988 we designed and tested a hollow-anode ignitron at levels of up 925 kA and 280 C per shot. This level is three times that previously achieved with standard, commercially available tubes. Our latest designs, developed with the cooperation of industry, incorporate a hollow anode into an industrial ignitron. Prototypes have recently achieved levels of 770 kA and 270 C per shot. 4 refs., 6 figs., 1 tab.

44294 The physics of laser plasma interactions. Kruer, W.L. 182p. Addison-Wesley Pub. Co. Inc., Reading, MA (1988).

Contents, abridged: Computer simulation of plasmas using particle codes. Propagation of obliquely incident light waves. Collisional absorption of electromagnetic waves in plasmas. Parametric excitation of electron and ion waves. Stimulated Raman scattering. Stimulated Brillouin scattering. Heating by plasma waves. Laser plasma experiments.

44295 Recent progress in inertial confinement fusion at Livermore. Bangerter, R.O. (Lawrence Livermore National Lab., CA (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 278(1): 34-37 (15 May 1989). (CONF-8806101–: International symposium on heavy ion inertial fusion, Darmstadt (Germany, F.R.), 28-30 Jun 1988).

Progress since the last Heavy-Ion Fusion Symposium has moved us much closer to demonstrating the scientific and technological requirements for inertial confinement fusion. By operating the Nova laser at the third harmonic of 1.06 μm light, we have virtually eliminated earlier concerns about hot electrons. A wide variety of diagnostics provide high-quality data. For example, the burning fuel is now imaged by 150 ps X-ray framing cameras and a new penumbral neutron imaging technique. The experimental data from Nova agree well with computer simulations. (orig.).

44296 Research on ion induction linacs at Berkeley. Fessenden, T.J. (Lawrence Berkeley Lab., CA (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 278(1): 13-18 (15 May 1989). DOE Contract AC03-76SF00098. (CONF-8806101–: International symposium on heavy ion inertial fusion, Darmstadt (Germany, F.R.), 28-30 Jun 1988).

Since October 1983 most of the research in the USA on heavy-ion fusion (HIF) has been devoted to the physics and technology of the induction linac driver. The economic viability of the method was confirmed in the recent HIF systems assessment study. Research at Berkeley comprises three experimental activities: (a) the multiple-beam experiment, MBE-4, which accelerates four parallel, separately focused beams of cesium ions from 0.2 to 1 MeV, and in which amplification of the beam power by a factor of nearly 40 is observed; (b) development of a 16-beam pulsed 2 MV injector; and (c) a single beam transport experiment (SBTE) for studying collective phenomena in ion beam transport. In addition, a major activity has been the development of a physics and engineering design for a larger experiment to test (in a scaled way) almost all of the manipulations needed in a full-scale driver. A complicating feature in the design is the combining of beams (in sets of four to one); the penalty in collectively enhanced emittance growth must be balanced against the cost savings gained in a driver. (orig.).

44297 Photoionization of beam ions. Langdon, A.B. (Lawrence Livermore National Lab., CA (USA)); Bangerter, R.O.; Liberman, D.A. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 278(1): 68-71 (15 May 1989). DOE Contract W-7405-ENG-48. (CONF-8806101–: International symposium on heavy ion inertial fusion, Darmstadt (Germany, F.R.), 28-30 Jun 1988).

In addition to the role of photoionization in the context of ionizing the gas in the target chamber, the possible importance of photoionization of the ion beam itself by thermal radiation emitted by the target as it heats was pointed out by W. Herrmannsfeldt. Rough estimates show this could be of interest due to its effect on the focusing of the beam. We used X-ray output spectra from the LASNEX modeling of targets driven by 1-5 MJ, and photoionization cross sections for Pb^{n+} to calculate the position and time-dependent photoionization of a beam of Pb^{3+} ions. Then we made estimates of this effect on beam dynamics. We found that half the ions at the end of the pulse have been photoionized by the time they reach $\simeq$ 20 cm from the target. In a simple model of the electrostatic forces, half the beam is deposited outside the intended spot. (orig.).

44298 Generation of stable mixed-compact-toroid rings by inducing plasma currents in strong E rings. Jayakumar, R. (GE Medical Systems, General Electric Co., Florence, SC (US)); Taggart, D.P.; Parker, M.R.; Fleischmann, H.H. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 17(1): 41-44 (Feb 1989).

In the RECE-Christa device, hybrid-type compact toroid rings are generated by inducing large toroidal plasma currents I_{tho} in strong electron rings using a thin induction coil positioned along the ring axis. Starting from field-reversal values δ_o = 50 - 120 percent of the original pure fast-electron ring, the induced plasma current I_{tho} raises δ to a maximum value of up to 240 percent with I_{tho} contributing more than 50 percent of the total ring current. Quite interestingly, the generated hybrid compact toroid configurations appear gross-stable during the full I_{tho} pulse length (half-amplitude width about 100 μs).

44299 Three-dimensional magnetohydrodynamic simulations of field error effects in ZT-H and ZT-40 reversed-field pinch devices. Sidikman, K.L. (9512470); Nebel, R.A.; Callen, J.D. *Fusion Technology (USA),* 15(1): 29-36 (Jan 1989).

Magnetic perturbations caused by field errors may pose a threat to magnetic confinement. They can cause the formation of magnetic islands, which may increase transport. The response of a reversed-field pinch (RFP) plasma to field errors has been calculated

numerically. A three-dimensional nonlinear magneto-hydrodynamic code was used, with field errors specified as boundary conditions. Two types of field errors were studied: those arising from current flowing in the toroidal field coil set and those arising from induced currents in the conducting shell flowing around holes. Design data from two RFPs at the Los Alamos National Laboratory - ZT-40 (currently operating) and ZT-H (being designed) - were used. Results on the effect of the plasma on the radial field perturbation and on island size are given. The effects of the chosen equilibrium current profile resistivity, and viscosity are discussed.

44300 Formation and steady-state sustainment of a tokamak by coaxial helicity injection. Jarboe, T.R. (9512470). *Fusion Technology (USA),* 15(1): 7-11 (Jan 1989).

A possible method for steady-state sustainment of a tokamak through coaxial helicity injection is presented. To keep the toroidal flux constant, two insulators are used, one that injects and one that absorbs toroidal flux. The scheme is made attractive by incorporating the toroidal field of the tokamak in the source to raise its impedance.

44301 Time-dependent simulations of a Compact Ignition Tokamak. Stotler, D.P. (5313000); Bateman, G. *Fusion Technology (USA),* 15(1): 12-28 (Jan 1989).

Detailed simulations of the Compact Ignition Tokamak are carried out using a 1 1/2-dimensional transport code. The calculations include time-varying densities, fields, and plasma shape. Ignition can be achieved in this device if somewhat better than L-mode energy confinement time scaling is possible. The performance of such a compact, short-pulse device can depend greatly on how the plasma is evolved to its flattop parameters. Furthermore, in cases such as the ones discussed here, where there is not a great deal of ignition margin and the electron density is held constant, ignition ends if the helium ash is not removed. In general, control of the deuterium-tritium density is equivalent to burn control.

44302 Beam funneling studies at Los Alamos. Stovall, J.E. (Los Alamos National Lab., NM (USA)); Guy, F.W.; Stokes, R.H.; Wangler, T.P. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 278(1): 143-147 (15 May 1989). (CONF-8806101–: International symposium on heavy ion inertial fusion, Darmstadt (Germany, F.R.), 28-30 Jun 1988).

Funneling two ion beams by interlacing their bunches can reduce the cost and complexity of systems producing intense beams. Applications of funneling could include accelerators for heavy-ion inertial fusion, electronuclear breeding and fusion materials irradiation. Funneling in an RFQ-like structure is an elegant solution at low energy where electric fields are needed to provide strong focusing. Discrete-element funnels, with separate focusing elements, bending magnets, rebunchers and rf deflectors, are more flexible. At sufficiently high energies magnetic-quadrupole lenses can provide strong focusing in a discrete-element funnel. Such a funnel has been designed as a preliminary example of a second funnel in the HIBALL-II accelerator system. In a simulation, two Bi^{1+} (mass = 209 amu) beams at 0.5 MeV/A, 20 MHz and 40 mA, separated by 55 cm and angled at $\pm 6^0$ were combined into a single 80 mA beam at 40 MHz. Emittance growth was calculated, by a modified version of the PIC (particle-in-cell) code PARMILA, to be about 1%. Funnel design experience at Los Alamos has evolved rules of thumb that reduce emittance growth. Some of these are to maintain focusing periodicity and strength in both transverse and longitudinal directions; use strong focusing so that the bunch will be small; minimize angles of bend and rf deflection; adjust longitudinal focusing to produce a short bunch at the rf deflector; and design rf deflectors for a uniform electrical field. (orig.).

44303 Accelerator research on MBE-4, an experimental multibeam induction linac. Meuth, H. (Lawrence Berkeley Lab., CA (USA)); Fessenden, T.J.; Keefe, D.; Warwick, A.I. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 278(1): 153-162 (15 May 1989). (CONF-8806101–: International symposium on heavy ion inertial fusion, Darmstadt (Germany, F.R.), 28-30 Jun 1988).

The multiple-beam accelerator MBE-4 is a device for research toward a heavy-ion driver for inertial confinement fusion, based on the induction linac concept. Its main goal is proof of the principle of current amplification by acceleration and controlled self-similar beam pulse compression. Into the 16 m long device four beams, each with an initial current of 10 mA, are injected from a Marx-driven diode at 200 keV. The current amplification is up to ninefold, with a final beam energy of about 800 keV in the middle of the bunch. Now that all the apparatus' accelerator sections have been completed, installed and aligned, and its unaccelerated transport properties have been studied, our experimental research has reached the crucial phase of implementing appropriate accelerator schedules that approximate self-similar current-pulse compression. These schedules are established through a close interplay of computations using a one-dimensional simulation code and a manual empirical tuning procedure. In a first approach, with a rather vigorous schedule that uses most of the accelerator modules to their voltage limits, we have determined the limits of our capability for controlled pulse compression, mainly due to waveform shaping of the driving pulse-forming networks. We shall report on these results. In the future we will also aim for gentler schedules that would model an inertial confinement fusion scenario more closely. (orig.).

44304 Achromatic beam combiner and bend system for ILSE. Lee, E.P. (Lawrence Berkeley Lab., CA (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 278(1): 178-181 (15 May 1989). DOE Contract AC03-76SF00098. (CONF-8806101–: International symposium on heavy ion inertial fusion, Darmstadt (Germany, F.R.), 28-30 Jun 1988).

The lattice configuration of the beam combiner and bend system of the proposed induction linac system experiment (ILSE) is described. These subsystems must transport high-current ion beams having large momentum variations with a single pulse ($\Delta P/P_0 \leq \pm 0.1$) with minimal beam loss or emittance growth. Configurations which are achromatic through first order, including the effect of image fields, have been developed. Calculations of the beam envelope and centroid motion are made with the beam dynamics code HICURB, which includes strong space-charge effects and chromatic effects through all orders. (orig.).

44305 Thermal shock testing of candidate compact ignition Tokamak graphites. Croessmann, C.D. (9511392); Gilbertson, N.B.; Watson, R.D.; Whitley, J.B. *Fusion Technology (USA),* 15(1): 127-135 (Jan 1989).

Sandia National Laboratories, Division of Fusion Technology, has performed a series of tests in support of the Compact Ignition Tokamak first-wall tile design. A screening study was done to rank the thermal shock resistance of 25 candidate graphite materials. Standardized thermal shock samples were subjected to identical intense heat pulses generated by the electron beam test system. Most of the fine-grained graphites cracked, but none of the carbon-carbon (C-C) composite samples fractured. The best performing fine-grained graphites were, in order, Union Carbide's TS-1909, TS-1792, ATJ-S, and CGW, as well as Fiber Material Inc.'s (FMI's) high-density graphite (HDG).

44306 Erosion and redeposition of graphite by hydrogen plasmas. Goebel, D.M. (9523812); Conn, R.W.; Hirooka, Y.; Leung, W.K.; Nygren, R.E.; Tynan, G.R.; Bohdansky, J. *Fusion Technology (USA),* 15(1): 102-107 (Jan 1989).

The results of erosion and redeposition studies of graphite by hydrogen plasma bombardment in the PISCES facility are reviewed. The total erosion yields of several types of graphites have been measured during plasma exposure with ion fluxes of up to 2×10^{18} $cm^{-2} \cdot S^{-1}$, ion energies of 50 to 200 eV, and sample temperatures of 50 to 950^0C. Hydrogen and deuterium plasmas have been used to bombard Poco, ATJ, and pyrolytic graphites, and a four-directional carbon-carbon (C-C) composite weave. The erosion rates of all the graphites tested are about equal, suggesting that surface damage by the ion bombardment results in similar erosion yields. The C-C composite weave material showed an increased weight loss during initial exposure, and then equal or lower erosion yields compared to the other graphites.

44307 Hydrocarbon transport in a plasma boundary layer. Langer, W.D. (5313000); Ehrhardt, A.B. *Fusion Technology (USA)*, 15(1): 118-126 (Jan 1989).

The theory of carbon transport in a plasma boundary layers is important for understanding the impurity penetration, and carbon and hydrogen recycling, in tokamaks using carbon compounds as limiters and as wall coatings. Neutral carbon kinetics and transport at the edge of plasma devices where chemical release is a source of carbon are modeled. Plasma reactions with carbon and hydrocarbons are important for such modeling, and these collisional processes are summarized. Combining the reaction schemes and kinetics in the DEGAS code makes it possible to treat the neutral transport at the plasma boundary layer. Results of such modeling of the atomic carbon and methane distribution at the edge are presented for comparison with recent carbon probe experiments performed on the Divertor and Injection Tokamak Experiment (DITE).

44308 Induction linac drivers: Prospects for the future. Keefe, D. (Lawrence Berkeley Lab., CA (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands)*, 278(1): 266-270 (15 May 1989). (CONF-8806101--: International symposium on heavy ion inertial fusion, Darmstadt (Germany, F.R.), 28-30 Jun 1988).

This review is intended to place in perspective our current view of the parameter ranges for induction linac drivers that lead to attractive scenarios for civilian electrical power plants; there is a surprising degree of choice (a factor of 2 or so in most parameters) before any significant impact on the cost of energy results. The progress and goals of the US heavy-ion fusion accelerator research (HIFAR) program are reviewed. The step between the realization of the HIFAR goals and a full-scale driver is seen to be very large indeed and will require one or more significant intermediate steps which can be justified only by a commitment to advance the HIF method towards a true fusion goal. Historial anomalies in the way that fusion programs for both military and civilian applications are administered will need to be resolved; the absence of any presently perceived energy crisis results in little current sense of urgency to develop vigorous long-term energy solutions. (orig.).

44309 Scenarios for fusion energy. Herrmannsfeldt, W.B. (Stanford Linear Accelerator Center, CA (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands)*, 278(1): 276-280 (15 May 1989). DOE Contract AC03-76SF00515. (CONF-8806101--: International symposium on heavy ion inertial fusion, Darmstadt (Germany, F.R.), 28-30 Jun 1988).

Are there scenarios for the near future (5-10 years) in which the public interest in, and political support for, fusion energy are likely to increase significantly? If such a scenario should occur, what should the status of heavy-ion fusion be at that time so that it is looked upon as a favored approach? If such a status can be identified, what should the research strategy be so that this status can be achieved in a timely way? This paper will look for answers to the first two of the above questions. If the goal of a desired status can be identified, the research strategy may become obvious. Of the four long-term energy options - coal, solar, fission breeders and fusion - the present position of fusion is in fourth place, never having generated any power. However, coal has environmental and safety problems. Solar has limitations of cost, availability and space requirements. Fission in general, and breeder reactors in particular, have problems of cost, environment and public acceptance. To be accepted and elevated to a position of equality with the others, heavy-ion fusion must simultaneously avoid their real and perceived major flaws. To succeed, heavy-ion fusion must strive to be markedly the best fusion option. (orig.).

44310 An improved method of calculating flux coordinates. Rome, J. A. (Oak Ridge National Laboratory, P.O. Box 2009, Oak Ridge, Tennessee 37831 (US)). *Journal of Computational Physics (USA)*, 82(2): 348-361 (Jun 1989). DOE Contract AC05-84OR21400.

The twisty nature of stellarator geometry can be "hidden" from many calculations by basing a coordinate system on the twisty flux surfaces. A particularly good choice for this flux coordinate system, developed by A. H. Boozer, has straight field lines and a Jacobian that depends only on the magnitude of the magnetic field B. Boozer's original method of generating the coordinate system had difficulty in determining the correct harmonics when the rotational transform, t (the number of times a field line twists around the torus in the short direction for each transit in the long direction), is rational ($t=n/m$) and when the transform per field period is large. With this improved method, two field lines are used to calculate Boozer's flux coordinates on a given flux surface. This splits the spectra so that adjacent toroidal mode numbers are assigned to different spectra, and the correct amplitudes of overlapping harmonics can be determined. © 1989 Academic Press, Inc.

44311 Algorithm for the calculation of three-dimensional ICRF fields in tokamak geometry. Smithe, D.N.; Colestock, P.L.; Kashuba, R.J.; Kammash, T. *Transactions of the American Nuclear Society (USA)*, 57: 303 (1988). (CONF-881011--: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

One of the most promising schemes for heating plasmas to thermonuclear temperatures in magnetic fusion devices is radio-frequency heating, particularly at the ion cyclotron resonance frequency. Most studies of this problem assume the magnetic field that confines the plasma to be constant or at best one-dimensional, whereas in reality it is quite complex. In this paper the authors introduce a computational scheme that permits tractable calculation of three-dimensional full-wave solutions to the Vlasov-Maxwell equations under typical experimental conditions associated with the ion cyclotron range of frequencies. The method is unique in that power deposition to the plasma is determined via the anti-Hermitran part of a truncated warm plasma dielectric operator, rather than as the result of an assumed phenomenological frequency. The resulting computer code allows arbitrary variation of density, temperature, magnetic field, and minority concentrations in the poloidal plane by performing a convolution of poloidal in the radial variable. By assuming no inhomogeneity along the toroidal axis, an inverse transform over the parallel wave number is performed, yielding the global three-dimensional fast-wave solutions. The results are applied to such plasmas as exist in the Tokamak Fusion Test Reactor and find that a mild resonance structure in antenna loading exists that is related to the changing number of wavelengths between the antenna and the resonance layer.

44312 $^{244}CmO_2$/nat.-UO_2 hybrid blanket with flat fission power production. Sahin, S. (Gazi Univ. (Turkey)); Erisen, A.; Cebi, Y. *Transactions of the American Nuclear Society (USA)*, 57: 303-305 (1988). (CONF-881011--: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

In the present study, $^{244}CmO_2$ is mixed with nat.-UO_2 for the purpose of power flattening in a hybrid blanket with a reasonably high energy multiplication factor. Also, the temporal variations of the fission power density (FPD) are observed during an 18-month plant operation period. The main conclusion drawn from this work is that it became possible to keep a flat fission power profile (FPP) over a very long plant operation period of 18 months by simply omitting the beryllium multiplier in the blanket and keeping the neutron spectrum fairly unchanged throughout the fission zone. This reduced the efforts for fuel management to a minimum. A further observation focused on only minor variations of the integral neutronic data over longer plant operation periods. Among others, the fission power generation increase is also very modest. This results in an optimum investment for the nonnuclear island. The blanket burns up high-level nuclear waste ^{244}Cm effectively, with efficient electricity production and breeding of a new type of nuclear fuel ^{245}Cm with very superior nuclear properties. Finally, a warning should be issued for the careful international safeguarding of such a hybrid plant due to the extremely high quality of the bred plutonium fuel.

44313 Prospects for D-^{3}He fuels in field-reversed configurations. Kernbichler, W. (Univ. of Illinois, Urbana (USA)); Miley, G.H.; Heindler, M. *Transactions of the American Nuclear Society (USA)*, 57: 305-306 (1988). (CONF-881011--: Joint meeting of the European Nuclear Society and the American Nuclear Society, Washington, DC (USA), 30 Oct - 4 nov 1988).

The discovery of lunar ^{3}He has increased interest in the development of D-^{3}He fusion. One of the most attractive confinement

concepts for burning D-^{3}He is the field-reversed configuration (FRC). The good confinement due to the closed field lines combined with the high β and the divertor action of the open field lines are especially attractive to reduce radiation losses and to use direct conversion techniques for the diverted plasma flow. There is also some evidence that charged fusion products can produce a seed current, which, when combined with pellet refueling, could maintain the FRC, allowing steady-state operation. This is important for D-^{3}He operation, since the startup energy investment for this cycle is relatively large. One approach to startup involves the initial creation of a deuterium-tritium (D-T) plasma at $\approx$ 6 to 10 keV, triggering a thermal runaway toward an operating point of 50 to 100 keV for D-^{3}He and changing the fuel content from D-T to D-^{3}He. In the work discussed in this paper, the authors examine the feasibility and characteristics of a D-^{3}He-fueled FRC. Various figures of merit are calculated, including operational windows, ignition domains, nt and Tnt requirements, power densities, neutron production, and tritium load.

44314 Numerical studies of deuterium-tritium ignition in impact-fusion targets. Zubrin, R.M. (6807000); Ribe, F.L. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 17(3): 459-462 (Jun 1989).

A numerical one-dimensional solution of the Euler equations for an imploding spherical tungsten shell with internal deuterium-tritium gas is applied to study impact-fusion dynamics with parameters of fusion reactor relevance. Thermal conduction and radiative energy loss by the plasma are taken into account, as is heating by fusion generated alpha particles. A variety of target sizes and impact velocities are examined, and scaling laws for fusion yields are deduced which define possible parameters for conceptual commercial impact-fusion power reactors. It is found that shell energies and velocities of about 30 MJ and 110 km/s would be satisfactory. A commercial impact-fusion reactor based on such parameters is discussed.

44315 Tritium module for ITER/TIBER system code. Finn, P.A. (0448000); Busigin, A.; Kalyanam, K.M. *Fusion Technology (USA),* 14(2): 677-682 (Sep 1988). (CONF-880505–: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

A tritium module was developed for the ITER/TIBER system code to provide information on capital costs, tritium inventory, power requirements, and building volumes for these systems. In the tritium module, the main tritium subsystems - plasma processing, atmospheric cleanup, water cleanup, blanket processing - are each represented.

44316 Solubility of tritium in $Pd_{1-Y}Ag_Y$ alloys (Y = 0.00, 0.10, 0.20, 0.30). Lasser, R. (3563000); Powell, G.L. *Fusion Technology (USA),* 14(2): 695-700 (Sep 1988). (CONF-880505–: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

Solubility measurements of tritium (T) in $Pd_{1-Y}Ag_Y$ alloys (Y = 0.00, 0.10, 0.20, 0.30) are reported in the temperature range of 250 K to 733 K, the pressure range below 3 bar, and the concentration range of 0.001 to 0.64 hydrogen to metal atom ratio. To study isotopic effects, the pressure-concentration-temperature relationships of the hydrogen isotopes protium (H) and deuterium (D) have been measured using the same samples and experimental setup and to temperatures as high as 1500 K using a different set up and samples. The experimental data are compared with values for H and D determined by other groups. In the case of T, most of the data presented have not been determined before. From these data the Sieverts' constants were calculated which show a strong temperature and isotope dependence. Analytical expressions, based on models that assume various degrees to which the hydrogen can perceive the alloy composition of individual sites in an alloy, are given for the Sieverts' constants that allow the calculation of the standard Gibbs free energies, enthalpies and entropies of H, D and T in these alloys.

44317 The blanket interface to TSTA. Clemmer, R.G. (9502030); Finn, P.A.; Grimm, T.L.; Sze, D.K.; Anderson, J.L.; Bartlit, J.R.; Naruse, Y.; Yoshida, H. *Fusion Technology (USA),* 14(2): 657-662 (Sep 1988). (CONF-880505–: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

The requirements of tritium technology are centered in three main areas, (1) fuel processing, (2) breeder tritium extraction, and (3) tritium containment. The Tritium Systems Test Assembly (TSTA) now in operation at Los Alamos National Laboratory (LANL) is dedicated to developing and demonstrating the tritium technology for fuel processing and containment. TSTA is the only fusion fuel processing facility that can operate in a continuous closed-loop mode. The tritium throughput of TSTA is 1000 g/d. However, TSTA does not have a blanket interface system. The authors have initiated a study to define a Breeder Blanket Interface (BBIO) for TSTA. The first step of the work is to define the condition of the gaseous tritium stream from the blanket tritium recovery system. This report summarizes this part of the work for one particular blanket concept, i.e., a self-cooled lithium blanket. The total gas throughput, the hydrogen to tritium ratio, the corrosive chemicals, and the radionuclides are defined. Various methods of tritium recovery from liquid lithium were assessed: yttrium gettering, permeation windows, and molten salt extraction. The authors' evaluation concluded that the best method was molten salt extraction.

44318 Measurement of the solubility of tritium in copper and gold at high pressures. Swansiger, W.A. (5659000). *Fusion Technology (USA),* 14(2): 631-636 (Sep 1988). (CONF-880505–: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

An apparatus and technique were developed to measure the solubility of tritium in high diffusivity metals at tritium pressures up to 136 MPa (20,000 psia) and temperatures up to 700 K. The experiments described in this paper took advantage of the low detection limits for tritium and helium-3 to determine the solubilities of high pressure tritium in copper and gold at temperatures as low as 473 K, where solubilities are below the limits of detection for hydrogen or deuterium. Samples were exposed to high pressure tritium at an elevated temperature long enough to reach equilibrium, then cooled within seconds by dropping them into a cold (77 K) section of the apparatus, thereby immobilizing the dissolved tritium. Solubilities were then determined by acid dissolution/liquid scintillation counting or, alternatively, by vacuum fusion/helium-3 analysis. For both copper and gold, surface effects were found to be extremely important because (1) they greatly increased the time required for the samples to equilibrate with the tritium overpressure and (2) there was more tritium on and near the surface than was contained in the bulk of a sample. In the absence of trapping, the solubilities determined at high pressures at temperatures between 473 K and 673 K agreed well with extrapolations of solubilities measured at 0.1 MPa hydrogen and temperatures >873 K.

44319 HE^3 outgassing from four working palladium and uranium beds. Coronado, P.R. (9513035); Fearon, E.M.; Garza, R.G.; Shaw, J.F.; Souers, P.C.; Stump, R.K.; Tsugawa, R.T. *Fusion Technology (USA),* 14(2): 741-743 (Sep 1988). (CONF-880505–: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

The He^3 output from two palladium and two uranium beds that store T_2 and D-T was studied as a function of time. Three of the beds were started new and watched for 1 yr; the fourth bed was 12 yr old. All four beds were used in routine tritium handling. Initial stoichiometries were $PdT_{0.3}$ and $UT_{0.7}$ so that both operated at similar pressures from 1 to 130 kPa. The He^3 from palladium ranged from the 0.002 mol% lower level of sensitivity to 0.01% for Pd/T_2 at 1 yr of age. The U/T system showed 0.1% He^3 at 4 to 62 days and 0.1 to 10% at longer times, with the first cuts being high in He^3. The palladium bed with 95 to 97% pure T_2 enriches the output to as high as 97 to 99%.

44320 Increase of tritium permeation through resistant metals at 323 K by lattice defects. Maienschein, J.L. (9513035); McMurphy, F.E.; Duval, V.L. *Fusion Technology (USA),* 14(2): 701-706 (Sep 1988). (CONF-880505–: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

The authors report data on tritium permeation at 323 K and 373 K through annealed and single crystal copper for comparison with earlier data on unannealed copper, and show that tritium transport

along grain boundaries or other lattice defects controls the overall rate at 323 K in unannealed material. Measurements on unannealed and annealed gold foil also indicate the importance of defect transport, although with gold the authors could not reduce the defect concentration sufficiently to measure permeation through the metal lattice. They also include permeation data on aluminum, molybdenum, tungsten, beryllium, cadmium, tritium, lead, rhenium, and silver; all of these were probably dominated by tritium transport along lattice defects.

44321 Lithium test module on ITER/TIBER. Finn, P.A. (0448000). *Fusion Technology (USA),* 14(2): 798-803 (Sep 1988). (CONF-880505--: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

ITER/TIBER (ITER) is the U.S. version of the design for the International Thermonuclear Experimental Reactor. The role of ITER is to test nuclear components for fusion power reactors. A major nuclear component to be tested is the breeder blanket and its associated tritium recovery system. To assist in the design of ITER, the engineering design of different blanket systems was done. This report summarizes a design of the tritium recovery system for a liquid lithium blanket, a prime candidate for a fusion power reactor. Objectives of this design were to ensure that a reliable, integrated performance of the tritium recovery system could be demonstrated and that the tritium could be measured. The latter objective permits one to validate the performance of the blanket module. For the tritium recovery system, the contractors and the electrolysis units were sized and costed. The magnetic force on the contactor was assessed. The tritium inventory for the system and the blanket module was calculated. Tritium recovery systems for larger blanket units could be designed using the information developed in this report.

44322 Parameters important in the oxidation of tritium at a stainless steel surface. Finn, P.A. (0448000); VanDeventer, E.H. *Fusion Technology (USA),* 14(2): 783-790 (Sep 1988). (CONF-880505--: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

The heterogeneous reaction between oxygen/helium gas, tritium and stainless steel was studied at the back surface of a stainless steel tube. The yield of tritiated water was determined as a function of oxygen concentration, tritium concentration, protium concentration, flow rate, and temperature. This report describes the results for two sets of runs done at 550°C with and without 15 ppm protium in the oxygen/helium gas. At oxygen concentrations of 40 ppm, the presence of excess protium in the oxygen/helium produced a reduced yield of tritiated water. At oxygen concentrations >1000 ppm, the two yields were equivalent, 98%.

44323 Effect of the self-pumped limiter concept on the tritium fuel cycle. Finn, P.A. (0448000); Sze, D.K.; Hassanein, A. *Fusion Technology (USA),* 14(2): 791-797 (Sep 1988). (CONF-880505--: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

The self-pumped limiter concept was the impurity control system for the reactor in the Tokamak Power Systems Study (TPSS). The use of a self-pumped limiter had a major impact on the design of the tritium systems of the TPSS fusion reactor. The self-pumped limiter functions by depositing the helium ash under a layer of metal (vanadium). The majority of the hydrogen species are recycled at the plasma edge; a small fraction permeates to the blanket/coolant which was lithium in TPSS. Use of the self-pumped limiter results in the elimination of the plasma processing system. Thus, the blanket tritium processing system becomes the major tritium system. The main advantages achieved for the tritium systems with a self-pumped limiter are a reduction in the capital cost of tritium processing equipment as well as a reduction in building space, a reduced tritium inventory for processing and for reserve storage, an increase in the inherent safety of the fusion plant and an improvement in economics for a fusion world economy.

44324 Tritium storage in ion-exchanged zeolites. Maienschein, J.L. (9513035); McMurphy, F.E.; Uribe, F.S. *Fusion Technology (USA),* 14(2): 775-782 (Sep 1988). (CONF-880505--: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

Cesium-exchanged Type 4A zeolites can encapsulate high-pressure tritium by physical entrapment in interior pores. The authors present data on storage capacity related to physical pore volume in the zeolite, and show that storage stability is reasonably good for short periods. Their data also shows that the zeolite releases helium while retaining tritium. Results are analyzed in terms of a diffusion model in the literature. The zeolite showed no structural change after a radiation dose of 10^8 Gy; it is unclear if radiation affects storage stability.

44325 Pyrophoricity of tritium-storage bed materials. Longhurst, G.R. (9502158). *Fusion Technology (USA),* 14(2): 750-755 (Sep 1988). (CONF-880505--: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

Experiments were conducted on samples of depleted uranium and on intermetallic compounds of zirconium-cobalt and lanthanum-nickel-aluminide to evaluate the pyrophoricity of the activated materials and their hydrides and deuterides on exposure to air. None of the materials spontaneously ignited when exposed to room temperature air, but the uranium and the zirconium-cobalt both ignited in air at moderately elevated temperatures. Activated dehyrdided materials ignited at essentially the same temperatures. Deuterides showed effectively the same characteristics as the hydrides except the ignition temperature of zirconium-cobalt deuteride was reduced by 20 - 50 K from that of the hydride. The pyrophoricity of these materials raises concern about the possibility of fires in tritium-storage beds with attendant damage to the bed and dispersal of tritiated debris, but fires may not occur until the bed is heated.

44326 Some new techniques in tritium gas handling as applied to metal hydride synthesis. Nasise, J.E. (9512470). *Fusion Technology (USA),* 14(2): 744-749 (Sep 1988). (CONF-880505--: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

A state-of-the-art tritium Hydride Synthesis System (HSS) was designed and built to replace the existing system within the Tritium Salt Facility (TSF) at the Los Alamos National Laboratory. This new hydriding system utilized unique fast-cycling 5.63 mole uranium beds (50.9 g to T_2 at 100% loading) and novel gas circulating hydriding furnaces. Tritium system components discussed include fast-cycling uranium beds, circulating gas hydriding furnaces, valves, storage volumes, manifolds, gas transfer pumps, and graphic display and control consoles. Many of the tritium handling and processing techniques incorporated into this system are directly applicable to today's fusion fuel loops.

44327 Implantation-driven tritium permeation in vanadium alloy fusion reactors. Holland, D.F. (9502158); Anderl, R.A. *Fusion Technology (USA),* 14(2): 707-712 (Sep 1988). (CONF-880505--: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

The safety concerns resulting from tritium implantation into vanadium and vanadium alloys have been studied. Tests were conducted to measure the physical constants that determine permeation and inventory in these materials. Surface recombination coefficients, enhancement factors due to plasma sputtering, and the diffusion constants were measured. To determine the implications of these results, application was made to the TITAN-I fusion reactor design. For this design, the tritium permeation rate and inventory buildup in the first wall was calculated for a range of surface conditions on the coolant side.

44328 Effect of impurities on ions in tritium. McConville, G.T. (9515000). *Fusion Technology (USA),* 14(2): 869-875 (Sep 1988). (CONF-880505--: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

Tritium has a steady state ion concentration of about one part in 10^9 of the background molecules. It will be shown that the recombination with electrons limits the ion density and the recombination is faster if the ions is in an excited vibrational state . These ions determine the reaction rates with other gases. When impurities of the order of 1 ppm are present, the ion resides on the impurity. Impurities are shown to affect the temperature dependence of the $D_2 + T_2$ reaction. The decrease in reaction rate with increasing temperature above 200 K is consistent with the increasing vapor pressure of an

impurity, but the level must be below 10 ppm. Unfortunately such an impurity may be below the level of our present detectability. How this situation may come about in the DT reaction is discussed in this paper.

44329 Ammonia in tritium systems. Gill, J.T. (9515000); Ellefson, R.E.; Paulick, R.P.; Colvin, C.M.; Yauger, R.L.; Johns, E.E.; Anderson, R.L.; Lewis, E.L.; Lamberger, P.H.; Vallee, R.E. *Fusion Technology (USA)*, 14(2): 876-883 (Sep 1988). (CONF-880505–: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

A recent tritium inventory imbalance at Mound required an investigation into its causes. Much tritium was found as HTO in unsuspected zeolite traps of a T-purification system. Isotropic exchange from ammonia was postulated as a mechanism for entry of T into the zeolitic water. Gases from a T-processing system which had experienced air in-leakage were shown, by trapping of condensibles, to contain substantial H-isotropic waters and ammonias. Further evidence for tritiated ammonia was inferred from changes in pressure and T purity in otherwise unperturbed tanks of N_2 and $(H/D/T)_2$. From two such tanks which held N_2 and T_2 at equilibrium, ammonia was trapped and decomposed; a preliminary equilibrium constant for $N_2 + 3T_2 <> 2NT_3$ was determined. Controlled experiments by laser Raman spectrometry are in progress to investigate N_2/T_2 equilibria and kinetics. Results for gas mixtures in the 60 - 130 kPA (500 - 1000 torr) range (per reactant) suggest that forward rate and the equilibrium attained are proportional to $[T_2]$. G-values for NT_3 production were ~1 - 2 molecules $atm^{-1}(T_2)$ $(100eV)^{-1}$. Self-decomposition of NT_3 proceeded in an exponential decay with a G = 15 - 30. A lower value was observed at pressures where β^--absorption in the gas was poor.

44330 Synthesis and stability of liquid molecular DT. Pearon, E.M. (9513035); Garza, R.G.; Griffith, C.M.; Mayhugh, S.R.; Mapoles, E.R.; Sater, J.D.; Souers, P.C.; Tsugawa, R.T.; Gaines, J.R.; Collins, G.W. *Fusion Technology (USA)*, 14(2): 864-868 (Sep 1988). (CONF-880505–: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

Regular equimolar deuterium-tritium is a mixture of 25 mol% T_2-50% DT-25% D_2. The authors have synthesized molecular DT of greater purity by the reaction $LiT + CH_3OD \rightarrow DT + LiOCH_3$, run at 243 K. With both the alcohol and reactor-to-cryostat transfer lines at room temperature, they obtain the 88 mol% DT purity. By cooling the alcohol and holding the transfer lines at 80 K, the yield rose to 95% DT. The DT disproportionated to D_2 and T_2 with a 1/e time constant of about 100 hr in the liquid at 20.5 K. Nuclear magnetic resonance data showed that the eventual T_2-DT-D_2 equilibrium is probably a hot-atom one.

44331 Triton memory time in solid DT and its nuclear polarization. Souers, P.C. (9513035); Fearon, E.M.; Mapoles, E.R.; Gaines, J.R.; Sater, J.D.; Collins, G.W.; Sherman, R.H.; Bartlit, J.R. *Fusion Technology (USA)*, 14(2): 855-863 (Sep 1988).

The expected value of nuclear spin polarization to inertial confinement fusion is recapitulated. A comparison of brute force polarization versus dynamic nuclear polarization, as applied to solid deuterium-tritium, is given, and the need for a long triton polarization memory time (longitudinal nuclear relaxation time) is shown. The time constant for 25 mol%T_2-50 DT-25 D_2 (D-T) is a short 0.3 s at 5 K and waiting in the presence of tritium radioactivity lowers it to 0.1 s. Enriched 90 to 96% molecular DT has been synthesized and held 3 to 4 hours at 10 K, which lowers the overall J = 1 T_2 concentration to about 0.1%. The resulting memory time can be raised in this way to 0.7 to 0.8 s. These samples were then melted and nH_2 added, which increased the memory times to 6 to 8 s - an increase of twenty-fold over regular D-T at 5 to 6 K. The theory shows that the species shortening the triton memory time is the J = 1 T_2, which can be reduced in our samples only by radioactive self-catalysis. Cryogenic distillation is considered as a possible means of removing the J = 1 T_2 from molecular DT.

99 GENERAL AND MISCELLANEOUS

Refer also to citation(s) 41777, 42923

44332 (INIS-mf–11503, pp. 31-33) **Comparison between measured and calculated spectra: An algorithmic approach.** Ofek, R. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Engineering). Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989*. Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Summary only.

44333 (JINR-N–4(30)-88) **JINR rapid communications. Collection of papers.** Joint Inst. for Nuclear Research, Dubna (USSR). 1988. 109p. Order Number DE89012196/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; INIS.

Individual papers are processed separately. (DLC)

44334 (OH–85-156-K) **Environmental and inorganic research section - 1984 annual report.** Dodd, D.J.R. Ontario Hydro Research Lab., Toronto, ON (Canada). May 1985. 39p. Order Number DE89635690/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

In 1984, the section made significant contributions to the state of knowledge and technology in several areas such as; conducting polymers for advanced batteries, separation of hydrogen isotopes by chromatographic methods, ion exchange resin performance in nuclear circuits, decontamination processes, concentration mechanisms and corrosion processes under deposits in nuclear steam generators, steam generator chemical cleaning, and processes for immobilizing high level liquid wastes. New work was started in a variety of areas such as applications of plasma technology and electrochemistry in chemical processes, dew point measurement and molecular sieve drier technology in nuclear applications, and limestone injection for sulphur dioxide removal from stack gases. Ongoing capabilities in combustion research and environmental aspects of solid waste disposal and wastewater treatment were also maintained. Most of these programs will continue in 1985.

9901 Management

Refer also to citation(s) 44397

44335 (AECL–8848) **Progress report - Health Sciences Division - 1985 January 01 - June 30.** Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Sep 1985. 121p. (PR-HS–19). Order Number DE89635688/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

This progress report contains a topical summary of major research in the Health Sciences Division. Separate reports are included for each of the following branches: Dosimetric Research, Environmental Research, Radiation Biology, and Medical. Some of the main areas of interest discussed are the impact of studies on cultured human fibroblasts with abnormal carcinogen sensitivity. This includes mechanisms of DNA repair and for the initiation of cancer, contribution of such genes to overall societal cancer burden, impact on risk assessment, distribution of risk, and radiation protection, application to improved treatment of cancer, screening for abnormal carcinogen sensitivity and Roberts syndrome.

44336 (AECL–9681) **Progress report Physics and Health Sciences. Health Sciences section. 1987 July 01-December 31.** Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Mar 1988. 141p. (PR-PHS-HS–4). Order Number DE89620467/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

This report covers the fourth semi-annual period since the Research Company was reorganized. We now have eight research fellows on staff, six fully funded by Physics and Health Sciences (P and HS). The first section of this report contains an excellent topical review of the program in Health Sciences on tritium toxicity which involves scientists from all three of the Chalk River branches of Health Sciences. Their work on cancer proneness is expanding data on apparently normal people and has been extended to include cancer patients. All tests are now blind. The work was the subject of two very fine TV presentations, one each shown on the

French and English networks of the CBC. Investigation also continues on the complex influence of hyperthermia on cancer induction and promotion. The potency of natural killer cells in human blood which have the ability to recognize and destroy cancerous cells have been shown to be very sensitive to temperature. A method may have been found for extending the life of T-lymphocytes grown in culture beyond the present 30 to 60-day limit. Activities in environmental research are moving in the direction of studies of a more fundamental nature so that the results will have a certain portability. Model studies form a large part of this new emphasis and notable among those is the Twin Lakes tracer study. Work is in progress to follow the plume the full 240 metres to the discharge zone with considerable success in the mathematical modelling. Members of the Health Sciences unit at CRNL were active as resource people for the Hare Commission on Ontario Nuclear Safety Review during the late fall. At Partnerships for Profit, which brought 85 senior executives of Canadian business in contact with the Research Company's capabilities, Physics and Health Sciences manned four booths on cancer screening, environmental protection, ANDI and nuclear physics instrumentation.

44337 (CNEA-NT–41/87) **Annual report 1985 Chemistry Department.** Comision Nacional de Energia Atomica, Buenos Aires (Argentina). 1987. 108p. (In Spanish). (CNEA-D-Q–6). Order Number DE89620468/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

This annual report describes the activities carried out in 1985 by the Chemistry Department in the following fields: Chemistry, Inorganic Chemistry, Physicochemistry (Interphases, Surfaces), General Chemical Analysis, Active Materials Analysis, X Ray Fluorescence Analysis, Mass Spectroscopy (Isotopic Analysis, Instrumentation) and Optical Spectroscopy. A list of publications is enclosed. (M.E.L.).

44338 (IAE–4719/3) **Main trends in research and development works of nuclear centres in USA, UK, France, FRG and Japan. Pt. 2 Uk, France, FRG.** Ivanova, L.M.; Mironov, V.D.; Panin, V.I.; Sidorov, P.S.; Shkutov, V.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1988. 48p. (In Russian). Order Number DE89635676/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Data on composition, structure and scientific trends of main nuclear centers in Great Britain, France, FRG are systematized. Main tendencies for development of prior trends in atomic acience nucleonics are detected and national peculiarities of nuclear programs developed are determined as result of analysis of research and development works, budget allocations and staff of nuclear center. 12 refs.; 10 figs.; 7 tabs.

44339 (KFK–4530) **Annual report 1988 of the Central Safety Department.** Koelzer, W.; Urban, M. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit. Apr 1989. 233p. (In German). Order Number DE89911039/JAW. Available from NTIS (US Sales Only), PC A11/MF A01.

The Central Safety Department is responsible for handling all problems of radiation protection, safety and security of the institutes and departments of the Karlsruhe Nuclear Research Center, for waste water activity measurements and environmental monitoring of the whole area of the Center, and for research and development work mainly focusing on nuclear safety and radiation protection measures. The r+d work concentrates on the following aspects: physical and chemical behavior of biologically particularly active radionuclides, behavior of tritium in the air/plant/soil system, biophysics of multicellular systems, improvement in radiation protection measurement and personnel dosimetry. This report gives details of the different duties, indicates the results of 1988 routine tasks and reports about results of investigations and developments of the working groups of the Department. The reader is referred to the English translation of the Table of Contents and of Chapter 1 describing the duties and organization of the Central Safety Department. (orig./HP).

44340 (NIRS-AR–30) **Annual report of National Institute of Radiological Sciences of the fiscal year 1986.** National Inst. of Radiological Sciences, Chiba (Japan). Nov 1987. 260p. (In Japanese). Order Number DE89906672/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

In fiscal year 1986, this Institute was alloted the budget of 6.4 billion yen, 16 % more as compared with the previous year. It was for promoting the various facilities for internal exposure experiment, the basic design of a heavy particle beam cancer treatment apparatus, the additional construction of the cyclotron building and other various works. As the research activities, the results of high level were obtained in four special researches on tritium, probabilistic effect, exposure evaluation and heavy particles. The case of neutron therapy has reached 1500 cases, and the adaptation to the therapy became clearer. The 14th environment seminar was held in December with the title 'Dynamic analysis of contamination mechanism in marine living things'. Also the 18th symposium on 'New development in chromosome research' was held. Due to the Chernoby1-4 accident on April 26, the medical examination of the travelers to USSR was carried out at international airports, and the report was made. As the program of the Regional Cooperation Agreement of IAEA, the training course for radiation therapy and the cooperation with the research on the diagnostic techniques of nuclear medicine were carried out. 39 personnel carried out international activities, and 63 foreign researchers visited the Institute. (K.I.).

44341 (OH–85-20-K) **Nondestructive and fracture evaluation section. 1984 review and 1985 work program.** Baron, J.A. Ontario Hydro Research Lab., Toronto, ON (Canada). Feb 1985. 45p. Order Number DE89635677/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The projects and achievements of the Nondestructive and Fracture Evaluation Section in 1984 are reviewed. Proposed projects and objectives for 1985 are described in outline.

44342 (OH–85-42-K) **Organic research section. 1984 review and 1985 programs.** Glass, R.W. Ontario Hydro, Toronto, ON (Canada). Research Center. Feb 1985. 29p. Order Number DE89635691/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This report reviews the major activities and accomplishments of the Organic Research Section in 1984 and presents the 1985 work program. The three major areas of the Section's research work are non-metallic materials which includes applications and uses of plastics, petroleum products, coatings and elastomers; reactor waste management; and activity transport/decontamination of nuclear systems. In 1984, 50% of the Section's resources were used on studies in support of nuclear generation, 13% on reactor waste, and 37% on general activities and work in support of utilization, transmission and distribution, and thermal and hydraulic programs. About 60% of the section's work was supported by transfer and revenue funds as a result of urgent short-term work requirements which resulted in 68% of the work falling into the technical investigation, consulting and testing categories.

9902 Mathematics and Computers

Refer also to citation(s) 41529, 41541, 41544, 41567, 41568, 41569, 41589, 41875, 41906, 41938, 41983, 41985, 42054, 42058, 42059, 42060, 42080, 42081, 42105, 42106, 42107, 42108, 42109, 42112, 42113, 42127, 42129, 42131, 42133, 42134, 42142, 42145, 42152, 42153, 42156, 42284, 42349, 42379, 42409, 42424, 42586, 42613, 42657, 42658, 42900, 42909, 42922, 42925, 42975, 42979, 42990, 42991, 42993, 42995, 43010, 43020, 43084, 43100, 43280, 43304, 43309, 43321, 43367, 43372, 43469, 43558, 43572, 43659, 43660, 43688, 43736, 43799, 44020, 44250, 44294, 44315

44343 (AD-A–206046/5/XAB) **PRASE (Parallel Resource Analysis Software Environment) Instrumentation software for the Intel IPSC hypercube. Master's thesis.** Kahl, M.A. Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering. Dec 1988. 211p. (AFIT/GCS/ENG–88D-11). Available from NTIS, PC A10/MF A01.

PRASE (Parallel Resource Analysis Software Environment) , developed at the Air Force Institute of Technology to support local users, consists of a set of subroutines and programs that aid a user in monitoring parallel-processing software targeted for an Intel iPSC

Hypercube. PRASE was in many ways patterned after Seecube, an effort by Alva Couch and others at Tufts University in Massachusetts. Like Seecube, instrumentation code must be embedded in a user's source code to facilitate data collection. After data are collected, a translator may be used to translate PRASE data into Seecube format. This allows application-specific instrumentation. Preprocessors for both C and Fortran automatically embed necessary subroutine calls using a user-defined configuration file. The data-collection subroutines are written in C and can be called by both C and Fortran. Data collected during program execution can be held in Hypercube memory and written to disk at the end of a run, or dumped periodically to disk during a run which may aid in debugging.

44344 (AD-A–206208/1/XAB) **Prospects for classifying complex imagery using a self-organizing neural network. Project report.** Menon, M.M.; Heinemann, K.G. Massachusetts Inst. of Tech., Lexington, MA (USA). Lincoln Lab. 11 Jan 1989. 31p. Available from NTIS, PC A03/MF A01.

The objective of this study is to evaluate the performance of Fukushima's Neocognitron model when it is applied to complex imagery. This system could discriminate between simple alphabetical characters represented in fields of 16 by 16 pixels, and that shift invariance can be achieved through a proper choice of design parameters. This work describes results for expanded Neocognitron architectures operating on complex images of 128 by 128 pixels. These neural network systems were simulated on a VAX-8600 minicomputer. Wire-frame models of three different vehicles were used to test the properties which Fukushima had demonstrated. The expanded Neocognitron systems were able to classify these objects and to identify their critical features. After training, each object was placed at different positions in the plane, and the Neocognitron's shift invariance property was tested. With complex (128 X 128) imagery, it was difficult to achieve proper classification and maintain shift invariance using only a few levels. In another experiment, the Neocognitron trained on polar transforms of objects in the training set. Objects in the training set were rotated, and polar transforms of the rotated images were submitted as input. In this manner, the Neocognitron's shift invariance was exploited to recognize rotated imagery. These investigations gave insight into the role of various model parameters and their proper values, as well as demonstrating the model's applicability to complex images.

44345 (AD-A–206284/2/XAB) **Structuring programs to support intelligent interfaces. Research report.** Szekely, P. University of Southern California, Marina Del Rey, CA (USA). Information Sciences Inst. Feb 1989. 25p. (ISI/RR–89-231). Available from NTIS, PC A03/MF A01.

The ability of connect user interface building blocks with a wide variety of application programs is crucial in the construction of intelligent interfaces. This paper presents a language to specify the communication between building blocks and application programs, with two important features: First, the language is abstract enough to isolate the application program from the details of particular interface styles. Second, the language is rich enough to support the communication of the information needed for the low-level aspects of the user interface. The paper also describes a UIMS(User Interface Management Systems) based on this language, and discusses how the language supports tools that can reason about the building blocks provided by the UIMS.

44346 (AD-A–206313/9/XAB) **Mapping for converting Mascot designs to ADA programs. Memorandum report.** Dean, T. Royal Signals and Radar Establishment, Malvern (UK). 19 Jul 1988. 24p. (RSRE-MEMO–4244). Available from NTIS, PC A03/MF A01.

The Future Networks section of CC1 division uses Mascot III in designing parallel systems. These designs are then implemented in the Ada programming language. A systematic method for mapping Mascot design into Ada programs has been developed, and this document describes the main characteristics of the method. In most applications, the mapping in its basic form is entirely adequate, and so a large part of the document is spent in describing this. However, certain situations present problems which can only be solved by making some alterations. Therefore, a short section on these problems and their solutions is also included. The method was chosen since it produces Ada programs with components corresponding directly to the Mascot design. This was considered a big advantage in producing maintainable and clear code. Mascot Templates (both algorithmic and structural) are represented as generic packages, and Mascot components are instantiations of those packages.

44347 (AD-A–206587/8/XAB) **Performance analysis of the DAP(trademark)-610 (Active Memory Technology's Distributed Array Processor) as data-compression processor in a real-time Remids system. Technical report, November 1988-March 1989.** Przebienda, L.M. Environmental Research Inst. of Michigan, Ann Arbor, MI (USA). Mar 1989. 29p. (ERIM–209700-1-T). Available from NTIS, PC A03/MF A01.

An analysis of the DAP 610 (Active Memory Technology's Distributed Array Processor) was undertaken to determine if the DAP-610 is capable of functioning as a major system component in a real-time processor. The evaluated functions required of the DAP-610 include: a direct link to an external multispectral sensor sending 16-bit data at a 1.65-MHz rate, demultiplexing and reformatting of sensor data, data compression processing, feature extraction, VME-bus input/output for communication with other system components, and out of high resolution image data for display. The DAP-610 was found to be capable of all these functions. However, processing-time estimates available are insufficient to verify that the implementations will operate within the real time constraints.

44348 (AD-A–206657/9/XAB) **Lexical analysis on a moderately sized multiprocessor. Technical report.** Low, J.R. Rochester Univ., NY (USA). Dept. of Computer Science. Oct 1988. 23p. (TR–261). Available from NTIS, PC A03/MF A01.

In the past few years, several computing systems have been developed that use traditional Von Neuman processors executing in parallel. These processors communicate at speeds which are only slightly slower than accesses to local memory. Communication is accomplished using message-passing and/or shared-memory techniques. These computers are described as MIMD (Multiple Instruction Multiple Data) machines. The term Moderately Sized Multiprocessor is used to describe MIMD systems that contain a moderate number (several dozen) of processors. Examples of such systems include the Cal Tech Cosmic-Cube, the NYU UltraComputer, the IBM, and the BBN Butterfly Computer. In this document a method for using dozens of conventional Von Nueman processors to tokenize programs in parallel is described. Results of a prototype implementation on the BBN Butterfly Computer are discussed.

44349 (AD-A–206852/6/XAB) **Learning in structured connectionist networks. Technical report.** Fanty, M.A. Rochester Univ., NY (USA). Dept. of Computer Science. Apr 1988. 99p. (TR–252). Available from NTIS, PC A05/MF A01.

Doctoral thesis.

Connectionist networks compute in a manner analogous to real neural networks. This work focuses on computing and especially learning in structured connectionist networks – those which emphasize problem-specific connection patterns as well as adaptive weight change rules. A connectionist chart parser was implemented which parses limited-length strings for context-free grammars in a constant number of parallel-computations steps. The parser was extended to disambiguate and complete near-miss parses, as well as learn new production in certain limited situations. While the parser works well, the structure is too rigid and learning too difficult for cognitive modeling. Two algorithms for learning simple, feature-based concept descriptions were also implemented. The first recruits hidden units representing pairs of features. The performance of this network is good when the definition involve pairs of input features, but attempts to build hierarchies of pair units for longer definitions were not successful. The second algorithm is an enhancement of an existing technique, competitive learning, adding feedback from concept units to guide the partitioning of inputs into classes. This technique is more successful and is used as a component in a network which is capable of learning descriptions of structured objects.

44350 (AD-A–206860/9/XAB) **Communication cost of sparse Cholesky factorization on a hypercube.** Gao, F.; Parlett, B.N. California Univ., Berkeley, CA (USA). Center for Pure and Applied Mathematics. Dec 1988. 15p. (PAM–436). Available from NTIS, PC A03/MF A01.

The authors consider the nested dissection ordering of a k x k grid of nodes and the Cholesky factorization of the associated k squared x k squared symmetric matrix. When the factorization is computed on a hypercube machine with p processors, then the communication cost (the total number of nonzero elements that need to be communicated among the processors) can be kept down to O (pk squared) when the processors are assigned appropriately. This result was proved in George, Liu and Ng (1987). The authors offer a simple proof of a slightly stronger result: the communication cost for each processor is O (k squared). Load balancing is built into the proof. Their argument extends to grids in more than 2 dimensions.

44351 (AD-A–206911/0/XAB) **Research on signal-processing supercomputers. Final technical report, September 1985-September 1986.** Kung, H.T. Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Computer Science. Sep 1988. 48p. Available from NTIS, PC A03/MF A01.

Signal processing is an area where the required computational bandwidth in an application can be unbounded. Applications such as radar, sonar and communications already call for signal-processing systems capable of delivering billions or tens of billions of operations per second. In developing a new signal processor to meet these requirements, it is essential to understand the underlying computational models. An ad-hoc processor development effort that is unclear on the computational models will likely be wasteful and unable to meet the long-term performance goal. Fortunately, because the control in signal processing is typically data-independent, computational models in this area can be relatively simple. Based on the study performed under this contract, this report describes some important computational models for parallel signal processing, and illustrates how the Warp machine developed by Carnegie Mellon supports these models. (jes)

44352 (ANL/EES-TM–376) **Evaluation of computer-aided software engineering tools for data base development.** Woyna, M.A.; Carlson, C.R. Argonne National Lab., IL (USA). Energy and Environmental Systems Div. Feb 1989. 23p. Sponsored by U.S. Department of Defense. DOE Contract W-31109-ENG-38. Order Number DE89014007/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

More than 80 computer-aided software engineering (CASE) tools were evaluated to determine their usefulness in data base development projects. The goal was to review the current state of the CASE industry and recommend one or more tools for inclusion in the uniform development environment (UDE), a programming environment being designed by Argonne National Laboratory for the US Department of Defense Organization of the Joint Chiefs of Staff, J-8 Directorate. This environment gives a computer programmer a consistent user interface and access to a full suite of tools and utilities for software development. In an effort to identify tools that would be useful in the planning, analysis, design, implementation, and maintenance of Argonne's data base development projects for the J-8 Directorate, we evaluated 83 commercially available CASE products. This report outlines the method used and presents the results of the evaluation.

44353 (CERN–89-06) **1988 CERN school of computing. Proceedings.** Verkerk, C. (ed.). European Organization for Nuclear Research, Geneva (Switzerland). 25 Apr 1989. 482p. (CONF-8808259–: CERN school of computing, Oxford (UK), 15-26 Aug 1988). Order Number DE89633843/JAW. Available from NTIS (US Sales Only), PC A21/MF A01 - OSTI; INIS.

These Proceedings contain written versions of most of the lectures delivered at the 1988 CERN School of Computing. Five lecture series concerned different aspects of parallel and vector processing: advanced computer architectures; parallel architectures for neurocomputers; Occam and transputers; vectorization of Monte Carlo code; and vectorization of high-energy physics code. Software engineering was the topic of three series of lectures: formal methods for program design; introduction to software engineering; and tutorial lectures on structured analysis and structured design. Lectures on data-acquisition and recording were followed by lectures on new techniques for data analysis in high-energy physics. Computer-assisted design of electronic systems, and silicon compilation and design synthesis for digital systems, were the topic of two other, closely related, lecture series. Lectures on accelerator controls and on robotics are also recorded in these Proceedings. Various other aspects of computing were covered in lectures on high-speed networks document preparation systems, interpersonal communication using computers, and on Fortran 8x. Two general lectures gave an introduction to high-energy physics at CERN. (orig.).

44354 (CONF-8607100–, pp. 1-4) **Introduction to NEUROCON-I.** Dress, W.B. (Oak Ridge National Laboratory, TN (USA)). Oak Ridge National Lab., TN (USA). May 1988. DOE Contract AC05-84OR21400. From NEUROCON 1 conference; 27-30 Jul 1986. In *NEUROCON-1: Proceedings.* Order Number DE88013108/JAW. Available from NTIS, PC A03/MF A01.

Interest in artificial neural systems modeled on natural intelligence has been largely dormant for about 30 years (except in the minds and dreams of a few mavericks). During that time artificial intelligence attempted to create ab initio software intelligence using higher-order cognitive constructs modeled by complex data structures. Now a renaissance of interest in biologically motivated computation has reached explosive proportions as measured by the rate of appearance of journal articles, books, and conferences such as this one. This renaissance was popularized by John Hopfield of Cal Tech, who provided some remarkable physical insights for understanding the functioning of highly abstract neural models. It is apparent that the time has come to heed the lessons learned by another dedicated group of researchers whose field is also undergoing a period of explosive growth - the neuroscientist. Understanding natural intelligence (including genetics and evolutionary principles) is essential if we ever wish to achieve intelligent machines. 4 references, 1 table.

44355 (CONF-8607100–, pp. 5-11) **Brain and neural-network simulations.** Browning, I. Oak Ridge National Lab., TN (USA). May 1988. From NEUROCON 1 conference; 27-30 Jul 1986. In *NEUROCON-1: Proceedings.* Order Number DE88013108/JAW. Available from NTIS, PC A03/MF A01.

The author approaches the subject from the standpoint of genetics, pointing out that the main difference between humans and lower animals life is a very simple genetic structure that caused over development of the human cortex. Further, he notes that, genetically, the heredity of an intelligent structure contains a lot less information than the structure itself. Experiments with Maitland Baldwin, chief neurosurgeon at NIH, are mentioned in which it was found that brain electrical output is not related to operation of the neurones. In his computerized simulation work at Sandia, he simplified the operating mechanism of the brain itself in order to get it into the computer. A neurone was something that counted and fired at some level. Each neurone had a number of synaptic inputs - a 1024-node net was used with an average of 12 synapse inputs per neurone. He found several kinds of paths in running this network. Since a pathway consisted of a learned time sequence concerning all permutations of connections, he concluded that the number of bits a neural network could hold was a combinatorial. 1 reference, 2 figures, 1 table.

44356 (CONF-8607100–, pp. 13-16) **Neural network modeling of individual propagation delays.** Knisley, J.R. (Oak Ridge National Laboratory, TN (USA)). Oak Ridge National Lab., TN (USA). May 1988. DOE Contract AC05-84OR21400. From NEUROCON 1 conference; 27-30 Jul 1986. In *NEUROCON-1: Proceedings.* Order Number DE88013108/JAW. Available from NTIS, PC A03/MF A01.

The Hopfield neural network is limited in application due to unwanted local minima, which trap the network as it settles to steady states. Most attempts at handling these unwanted local minima have involved probabilistic weighting or random noise that bumps the network out of local minima. This paper suggests a deterministic method for handling local minima, based on a property of actual neurons. Computer simulations of a modified Hopfield network with artificial neurons were made. Experimental results and observations are discussed. 5 references.

44357 (CONF-8607100–, pp. 17-23) **Comparison of three neural-network models.** Matheus, C.J. (Univ. of Illinois at Urbana-Champaign (USA)). Oak Ridge National Lab., TN (USA). May 1988. From NEUROCON 1 conference; 27-30 Jul 1986. In *NEUROCON-1: Proceedings.* Order Number DE88013108/JAW. Available from NTIS, PC A03/MF A01.

This paper presents briefly a comparison of the following computational neural networks: (1) the Rumelhart and Zipser Model; (2) the Boltzmann Machine; and (3) the Hopfield Network. With so few available machines to implement neural networks in parallel and so few practical neural systems in use, the most-promising approach found for making immediate use of neural networks on serial machines for pattern recognition is the Hopfield Network. The reasons are that the model is easy to implement, it has a simple and efficient threshold function, there exists a simple and fast learning procedure for storing memory states, and it is very effective as an associative memory. The Rumelhart and Zipser model is appealing in its ability to create new features based on experience with its environment; however, it could not be seen how these low-level features could be effectively integrated into a practical high-level system without a considerable effort. The Boltzmann Machine offers the potential for solving difficult constraint satisfaction problems with neural networks. However, because it uses a simulated annealing process, it is prohibitively slow for most practical applications. With the increased availability of massively parallel architectures, however, this and other approaches may soon find a place among more traditional problem-solving techniques. 7 references.

44358 (CONF-8607100–, pp. 25-41) **Neural network modeling of early retinal vision processes.** Jorgensen, C.C. (Oak Ridge National Laboratory, TN (USA)). Oak Ridge National Lab., TN (USA). May 1988. DOE Contract AC05-84OR21400. From NEUROCON 1 conference; 27-30 Jul 1986. In *NEUROCON-1: Proceedings*. Order Number DE88013108/JAW. Available from NTIS, PC A03/MF A01.

This paper considers two techniques to obtain values for parameters in models of vision processes in early layers of the human retina. The work is part of a long-term effort to develop a robot vision system using three computational principles of neural networks. These principles are massive parallelism, dynamic feedback, and multilayer pattern recognition. Two network models were studied. The first represented lateral inhibition processes as a matrix of two-dimensional linear equations with limited feedback. The second represented multilayer networks as matrices of dynamic, two-dimensional nonlinear differential equations. The lateral inhibition model was parameterized using psychophysical data from human judgments of pattern brightness in a machband illusion. A 2-D Fourier transform was mode of original and perceived patterns and used to solve for the coefficient matrix of the neural network. The coefficients were then applied to the pixel matrix of a Herman Grid illusion and compared with the corresponding human subjective results through three-dimensional plots of pixel intensities. The second model was analyzed using a new computer simulation developed to work with moving images and adjustable neural connection topologies. 19 references, 8 figures.

44359 (DOE/ER/25009–681b) **3-D asteroids using parallel graphics on NCUBE: A testbed for evaluating controller algorithms.** Ho, A.; Fox, G.; Snyder, S.; Chu, D.; Mylner, T. California Inst. of Tech., Pasadena, CA (USA). 18 Apr 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract FG03-85ER25009. (CONF-890372–15: 4. hypercube, concurrent computers and applications, Monterey, CA (USA), 6-8 Mar 1989). Order Number DE89016382/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have implemented on NCUBE a 3-D Asteroids video game system. The system functions as a testbed for evaluating intelligent controller algorithms within a simulated space battle framework. The Asteroids features battle of spacecrafts in a 3-D toroidal space with inert meteorites of various sizes. It supports multi-players and mixed communication protocols. The game can be played either in interactive or batch mode. In interactive mode a player can maneuver a spacecraft by keyboard or graphics tablet control like a regular pc-based video game. 3-D visual display of the game uses the NCUBE Real-Time Parallel Graphics Board which has 16 NCUBE processors and a Hitachi HD63484 drawing/video chip. In batch mode spacecrafts can be controlled by user-supplied software controllers. The modular structure of the game allows easy replacement of game objectives, game rules, and spacecraft controllers. The flexibility of module substitution allows fast prototyping of different controller strategies and algorithms which are constrained by various game rules. The system also allows algorithms that run on distinct subcubes of a hypercube to compete with one another. 6 refs., 1 fig.

44360 (DOE/ER/25009–695) **Neural networks and dynamic complex systems.** Fox, G.; Furmanski, Wojtek; Ho, Alex; Koller, J.; Simic, P.; Wong, Isaac. California Inst. of Tech., Pasadena, CA (USA). 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract FG03-85ER25009. (CONF-890360–6: Eastern multiconference, Tampa, FL (USA), 28-31 Mar 1989). Order Number DE89016380/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We describe the use of neural networks for optimization and inference associated with a variety of complex systems. We show how a string formalism can be used for parallel computer decomposition, message routing and sequential optimizing compilers. We extend these ideas to a general treatment of spatial assessment and distributed artificial intelligence. 34 refs., 12 figs.

44361 (DOE/ER/25009–769) **1989 – the first year of the parallel supercomputer.** Fox, G.C. California Inst. of Tech., Pasadena, CA (USA). 6 Jun 1989. 38p. Sponsored by U.S. DOE Energy Research. DOE Contract FG03-85ER25009. (CONF-890372–14: 4. hypercube, concurrent computers and applications, Monterey, CA (USA), 6-8 Mar 1989). Order Number DE89016373/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Parallel Computing has come of age with several commercial and in- house systems available which not only promise, but realize supercomputer or better performance. We survey several major computations underway on hypercubes, transputer arrays and the SIMD Connection Machine CM-2 and AMT DAP. Where possible, we compare parallel implementations with those on CRAY and other high performance conventional computers. We summarize these experiences as a set of lessons for applications, decomposition, performance, hardware and software for parallel machines. 94 refs., 18 figs., 9 tabs.

44362 (FNAL/C–89/120) **Event parallelism: Distributed memory parallel computing for high energy physics experiments.** Nash, T. Fermi National Accelerator Lab., Batavia, IL (USA). May 1989. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890415–10: Computing in high energy physics, 10-14 Apr 1989). Order Number DE89016285/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper describes the present and expected future development of distributed memory parallel computers for high energy physics experiments. It covers the use of event parallel microprocessor farms, particularly at Fermilab, including both ACP multiprocessors and farms of MicroVAXES. These systems have proven very cost effective in the past. A case is made for moving to the more open environment of UNIX and RISC processors. The 2nd Generation ACP Multiprocessor System, which is based on powerful RISC systems, is described. Given the promise of still more extraordinary increases in processor performance, a new emphasis on point to point, rather than bussed, communication will be required. Developments in this direction are described. 6 figs.

44363 (FNAL/C–89/130) **FEREAD: Front End Readout software for the Fermilab PAN-DA data acquisition system.** Dorries, T.; Haire, M.; Moore, C.; Pordes, R.; Votava, M. Fermi National Accelerator Lab., Batavia, IL (USA). May 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890545–11: 6. conference on real-time computer applications in nuclear, particle and plasma physics, 15-18 May 1989). Order Number DE89016333/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The FEREAD system provides a multi-tasking framework for controlling the execution of experiment specific front end readout processes. It supports initializing the front end data acquisition hardware, queueing and processing readout activation signals, cleaning up at the end of data acquisition, and transferring configuration parameters and statistical data between a "Host" computer and the readout processes. FEREAD is implemented as part of the PAN-DA software system and is designed to run on any Motorola 68k based processor board. It has been ported to the FASTBUS General Purpose Master (GPM) interface board and the VME MVME133A

processor board using the pSOS/Microtec environment. 12 refs., 2 figs.

44364 (FNAL/C–89/131) **A real time integrated environment for Motorola 680xx-based VME and FASTBUS modules.** Berg, D.; Heinicke, P.; MacKinnon, B.; Nicinski, T.; Oleynik, G. Fermi National Accelerator Lab., Batavia, IL (USA). May 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890545–9: 6. conference on real-time computer applications in nuclear, particle and plasma physics, Williamsburg, VA (USA), 15-18 May 1989). Order Number DE89015238/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Software Components Group pSOS operating system kernel and pROBE debugger have been extended to support the Fermilab PAN-DA system for a variety of Motorola 680xx-based VME and FASTBUS modules. These extensions include: a multi-tasking, reentrant implementation of Microtec C/Pascal; a serial port driver for terminal I/O and data transfer; a message reporting facility; and enhanced debugging tools. 5 refs., 1 fig.

44365 (FNAL/C–89/132) **Exabyte helical scan devices at Fermilab.** Constanta-Fanourakis, P.; Kaczar, K.; Oleynik, G.; Petravick, D.; Votava, M.; White, V.; Hockney, G.; Bracker, S.; de Miranda, J.M. Fermi National Accelerator Lab., Batavia, IL (USA). May 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890545–10: 6. conference on real-time computer applications in nuclear, particle and plasma physics, Williamsburg, VA (USA), 15-18 May 1989). Order Number DE89015237/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Exabyte 8mm helical scan storage devices are in use at Fermilab in a number of applications. These devices have the functionality of magnetic tape, but use media which is much more economical and much more dense than conventional 9 track tape. 6 refs., 3 figs.

44366 (FNAL/C–89/133) **Uniform communications software using TCP/IP.** Bernett, M.; Oleynik, G. Fermi National Accelerator Lab., Batavia, IL (USA). May 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890545–13: 6. conference on real-time computer applications in nuclear, particle and plasma physics, 15-18 May 1989). Order Number DE89016332/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Data acquisition applications at Fermilab require a reliable, distributed communication system for downloading, diagnostics, control, and data distribution. TCP/IP over Ethernet was chosen because of its uniform user interface and commercial availability for a number of processors and operating systems. This paper describes our software and hardware support for TCP/IP on VAX/VMS, VME/pSOS, FASTBUS/pSOS, and Unix systems. It includes plans to provide a portable, hardware independent implementation of TCP/IP based on Berkeley BSD software. 8 refs., 3 figs.

44367 (FNAL/C–89/134) **Software for FASTBUS and Motorola 68K based readout controllers for data acquisition.** Pordes, R.; Bernett, M.; Dorries, T.; Haire, M.; Moore, C.; Oleynik, G.; Votava, M. Fermi National Accelerator Lab., Batavia, IL (USA). May 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890545–14: 6. conference on real-time computer applications in nuclear, particle and plasma physics, 15-18 May 1989). Order Number DE89016330/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Many High Energy Physics experiments at Fermilab are now including FASTBUS front-ends in their data acquisition systems. The requirements on controllers to readout and control these FASTBUS systems are increasing in complexity and speed. The Data Acquisition Software group has designed general software for front end 68K processor boards housed in FASTBUS or VME to meet these needs. The first implementation has been developed for the General Purpose FASTBUS Master (GPM). This software is being ported to the FASTBUS Smart Crate Controller under development at Fermilab. The software is designed, using structured analysis tools and coding in C, to be easily portable in the future to new processor boards. As part of our extended support for FASTBUS, we have enhanced our software for the intelligent LeCroy 1821 FASTBUS interface and implemented the FASTBUS standard routines for the VAX/VMS operating system. 17 refs.

44368 (FNAL/C–89/135) **Remote procedure execution software for distributed systems.** Petravick, D.L.; Berman, E.F.; Sergey, G.P. Fermi National Accelerator Lab., Batavia, IL (USA). May 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890545–15: 6. conference on real-time computer applications in nuclear, particle and plasma physics, Williamsburg, VA (USA), 15-18 May 1989). Order Number DE89016329/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Remote Procedure Execution facilitates the construction of distributed software systems, spanning computers of various types. Programmers who use the RPX package specify subroutine calls which are to be executed on a remote computer. RPX is used to generate code for dummy routines which transmit input parameters and receive output parameters, as well as a main program which receives procedure call requests, calls the requested procedure, and returns the result. The package automatically performs datatype conversions and uses an appropriate connection oriented protocol. Supported operating systems/processors are VMS(VAX), UNIX(MIPS R2000, R3000) and Software Components Group's pSOS (680x0). Connection oriented protocols are supported over Ethernet (TCP/IP) and RS232 (a package of our own design). 2 refs., 2 figs.

44369 (FNAL/C–89/136) **The PAN-DA data acquisition system.** Petravick, D.; Berg, D.; Berman, E.; Bernett, M.; Constanta-Fanourakis, P.; Dorries, T.; Haire, M.; Kaczar, K; MacKinnon, B.; Moore, C.; Nicinski, T.; Oleynik, G.; Pordes, R.; Sergey, G.; Votava, M.; White, V. Fermi National Accelerator Lab., Batavia, IL (USA). May 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890545–12: 6. conference on real-time computer applications in nuclear, particle and plasma physics, 15-18 May 1989). Order Number DE89016328/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Online and Data Acquisition software groups at Fermi National Accelerator Laboratory have extended the VAXONLINE data acquisition package to include a VME based data path. The resulting environment, PAN-DA, provides a high throughput for logging, filtering, formatting and selecting events. 10 refs., 1 fig.

44370 (FNAL/C–89/142) **PAW [Physics Analysis Workstation] at Fermilab: CORE based graphics implementation of HIGZ [High Level Interface to Graphics and Zebra].** Johnstad, H. Fermi National Accelerator Lab., Batavia, IL (USA). Jun 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890415–9: Computing in high energy physics, 10-14 Apr 1989). Order Number DE89016327/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Physics Analysis Workstation system (PAW) is primarily intended to be the last link in the analysis chain of experimental data. The graphical part of PAW is based on HIGZ (High Level Interface to Graphics and Zebra), which is based on the OSI and ANSI standard Graphics Kernel System (GKS). HIGZ is written in the context of PAW. At Fermilab, the CORE based graphics system DI-3000 by Precision Visuals Inc., is widely used in the analysis of experimental data. The graphical part of the PAW routines has been totally rewritten and implemented in the Fermilab environment. 3 refs.

44371 (FNAL/C–89/143) **Physics analysis workstation.** Johnstad, H. Fermi National Accelerator Lab., Batavia, IL (USA). Jun 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890545–16: 6. conference on real-time computer applications in nuclear, particle and plasma physics, 15-18 May 1989). Order Number DE89016324/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Physics Analysis Workstation (PAW) is a high-level program providing data presentation and statistical or mathematical analysis. PAW has been developed at CERN as an instrument to assist physicists in the analysis and presentation of their data. The program is interfaced to a high level graphics package, based on basic underlying graphics. 3-D graphics capabilities are being implemented. The major objects in PAW are 1 or 2 dimensional binned

event data with fixed number of entries per event, vectors, functions, graphics pictures, and macros. Command input is handled by an integrated user interface package, which allows for a variety of choices for input, either with typed commands, or in a tree structure menu driven mode. 6 refs., 1 fig.

44372 (IKE–4-126) **Construction of an integrated system to solve partial differential equations on vector computers.** Mayer, R.P. Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme. Dec 1988. 148p. (In German). Order Number DE89795971/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; NTIS (US Sales Only), PC A07/MF A01.

This study deals with a system of programs which includes the latest developments of soft- and hardware and numerics. It enables the user to solve any system of partial differential equations, on the basis of the finite-element-method. FEPDES (Finite Element Partial Differential Equation Solver) is set up in a modular manner and is structured according to the rules of software engineering. The algorithmis can be run efficiently on a modern vector or parallel computer. Depending on the particular problem direct, iterative and hybride algorithms are available for the solution of linear systems of equations. FEPDES was validated by using examples of the fields of heat conduction, fluid mechanics and structural mechanics. Due to the modular structure and the numerical methods it is possible to assign the single steps of a FEPDES run to several computers. Preparation of input and interpretation of results can therefore be run easily on a workstation with advanced interactive and grafic capabilities. However, the more extensive set up and the solution of matrix equations can be run optionally on the workstation or on a highspeed-computer like the CRAY, respectively. (orig.).

44373 (LA–11448-MS) **Learning to use the finite-element mesh generator, ESCHER 3.2.** Oakes, W.R. Jr. Los Alamos National Lab., NM (USA). Aug 1989. 100p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE89015885/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

ESCHER is a finite-element mesh generator designed to generate valid and well proportioned two-dimensional and three-dimensional meshes. It is intended for use in a loosely integrated analysis system. Edge-geometry data can be input to ESCHER from almost any computer-aided drafting program used today. ESCHER produces a finite-element model in a neutral file format that can be translated for input to specific finite-element analysis codes. This report describes how to use ESCHER. It explains what constitutes a valid geometrical model, how to construct one from edge geometry, how to define a finite-element model given a geometrical model, and how to verify that the created model is valid. The computer-hardware system required is explained, and ESCHER's relationship to other computer codes in the Integrated Design Engineering Analysis Library, IDEAL, is discussed. 5 refs., 11 figs.

44374 (LA-UR–89-2255) **Optimization of the constrained algebraic reconstruction technique for the performance of a variety of visual tasks.** Hanson, K.M. Los Alamos National Lab., NM (USA). 1989. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890605–1: 11. international processing in medical imaging international conference, Berkeley, CA (USA), 19-23 Jun 1989). Order Number DE89015239/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This work demonstrates the application of a method to optimize image reconstruction algorithms on the basis of the performance of specific visual tasks that are to be accomplished using the reconstructed images. The evaluation of task performance is numerically realized by a Monte Carlo simulation of the complete imaging chain, including the final inference based on the reconstructions. Fundamental to this evaluation is that it yields an average response by consideration of many initial scenes. It is shown that the use of the nonnegativity constraint in the Algebraic Reconstruction Technique can significantly improve performance in situations where there is a severe lack of measurements when the relaxation factor is optimized. There is no indication in any of the cases studied hitherto that the nonnegativity constraint can improve performance in situations where the data are complete, but noisy. 10 refs., 5 figs.

44375 (PB–89-183669/XAB) **Towards a parallel algorithm for the many-body problem.** Esselink, K. Groningen Rijksuniversiteit (Netherlands). Subfaculteit Wiskunde en Informatica. 1988. 24p. (CS–8813). Available from NTIS, PC EE03/MF A01.

This paper reports on research done in order to find out whether a known sequential algorithm for the Many Body Problem was suitable for parallelization. The sequential algorithm as a time complexity believed to be O(N log N). The main issue is how to transform the algorithm into an efficient parallel one. The problem of how to distribute the work evenly among the different processors for this particular problem is considered. Also the data structure plays an important role. Since the structure tends to be very big for a problem like this, special constructs are necessary to manage it while it is distributed among various processors. Some results from tests with not-many-but-still-a-lot-of-bodies on a 16-Transputer System are shown and suggestions on how to proceed and improve the algorithm are given. The work presented is just an example of how to approach a large parallel computing task.

44376 (PB–89-185409/XAB) **Vector-processing performance on the Delft Parallel Processor.** Andriessen, J.H.M.; Brok, S.W.; Pasveer, F.J. Technische Hogeschool Delft (Netherlands). Dept. of Mathematics and Informatics Computer Science. 1988. 27p. (REPT–88-96). Available from NTIS, PC EE03/MF A01.

The applicability and performance of vector processing on the Delft Parallel Processor (DPP) are considered. With respect to the performance, primarily the effects of the parallel implementation of algorithms and of the architecture of the DPP are analyzed. In many engineering problems, the mathematical formulation leads to the solution of very large systems of linear equations: Ax=b. The DPP will be used to solve such systems. Therefore the relative performance of some well-known iterative methods (Conjugate Gradient, Gauss-Seidel and modified Wang) are examined. The DPP is an MIMD-multiprocessor. The present DPP at the Delft Computing Center comprises 16 Processing Elements (PEs). To speed up the data processing, the PEs are equipped with Vector Processing Units. Each PE can handle vectors within the order of 1000 elements.

44377 (PB–89-864235/XAB) **Parallel processing. July 1985-May 1988 (Citations from the NTIS data base). Report for July 1985-May 1988.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 121p. Available from NTISPC N01/MF N01.

See also PB–89-864243.

This bibliography contains citations concerning theoretical analyses and applications of parallel processing systems and operations. Topics include image and signal processing, programming languages, algorithm and architecture descriptions, and utilization in optimization problems. Descriptions of specific machines used in problem-solving systems are presented. (This updated bibliography contains 248 citations, none of which are new entries to the previous edition.)

44378 (PB–89-864243/XAB) **Parallel processing. June 1988-June 1989 (Citations from the NTIS data base). Report for June 1988-June 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 176p. Available from NTISPC N01/MF N01.

Supersedes PB–88-864152. See also PB–89-864235.

This bibliography contains citations concerning theoretical analyses and applications of parallel processing systems and operations. Topics include image and signal processing, programming languages, algorithm and architecture descriptions, and utilization in optimization problems. Descriptions of specific machines used in problem-solving systems are presented. (This updated bibliography contains 340 citations, all of which are new entries to the previous edition.)

44379 (SAND–88-1432) **BLOT: A mesh and curve plot program for the output of a finite element analysis.** Gilkey, A.P.; Glick, J.H. Sandia National Labs., Albuquerque, NM (USA). Jun 1989. 143p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89013994/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

BLOT is a graphics program for post-processing of finite element analysis output that is presented in the EXODUS database format. It is command driven with free-format input and can drive any graphics device supported by the Sandia Virtual Device Interface.

BLOT produces mesh plots with various representations of the analysis output variables. The major mesh plot capabilities are deformed mesh plots, line contours, banded contours, vector plots of two or three variables (e.g., velocity vectors), and symbol plots of scalar variables (e.g., temperature). Pathlines of analysis variables can also be drawn on the mesh. BLOT's features include element selection by material, element birth and death, multiple views for combining several displays on each plot, symmetry mirroring, and node and element numbering. BLOT can also produce X-Y curve plots of the analysis variables. BLOT generates time-versus-variable plots or variable-versus-variable plots. It also generates distance versus-variable plots at selected time steps where the distance is the accumulated distance between pairs of nodes or element centers. 14 refs.

44380 (SAND–89-0466) **The Product Data Network and Distributed Data System: Node configuration.** Hall, R.C. Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 39p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC04-76DP00789. Order Number DE89013996/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Prototype systems have been established which prove the concept and utility of supporting distributed access to shared Product Test Data from Sandia National Laboratories (SNL) and General Electric Neutron Devices (GEND) using existing network communications facilities. It is essential, however, that adequate control (audit and isolation) be present as intrinsic characteristics of this connectivity in the production environment. A plan has emerged to put into place a configuration which provides required network functionality, yet preserves the necessary control. This configuration supports further development of a Product Data Network containing a Distributed Data System. We anticipate a complete "black hat" assessment of the final plan and configuration which results from these efforts. 3 figs.

44381 (SKB-TR–89-19) **A Bayesian nonparametric estimation of distributions and quantiles.** Poern, K. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Nov 1988. 22p. Order Number DE89912026/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report describes a Bayesian, nonparametric method for the estimation of a distribution function and its quantiles. The method, presupposing random sampling, is nonparametric, so the user has to specify a prior distribution on a space of distributions (and not on a parameter space). In the current application, where the method is used to estimate the uncertainty of a parametric calculational model, the Dirichlet prior distribution is to a large extent determined by the first batch of Monte Carlo-realizations. In this case the results of the estimation technique is very similar to the conventional empirical distribution function. The resulting posterior distribution is also Dirichlet, and thus facilitates the determination of probability (confidence) intervals at any given point in the space of interest. Another advantage is that also the posterior distribution of a specified quantile can be derived and utilized to determine a probability interval for that quantile. The method was devised for use in the PROPER code package for uncertainty and sensitivity analysis. (orig.).

44382 Vectorizing compilers. Callahan, D. (Computer Science Dept., Rice Univ., Houston, TX (US)); Dongarra, J.; Levine, D. pp. 460 of Proceedings of IEEE supercomputing '88. IEEE Service Center, Piscataway, NJ (1988). (CONF-881112–: IEEE supercomputing '88, Orlando, FL (USA), 14-18 Nov 1988).

This report describes a collection of 100 Fortran loops used to test the effectiveness of an automatic vectorizing compiler. The authors present the results of compiling these loops using commercially available vectorizing Fortran compilers on a variety of supercomputers, mini-supercomputers, and mainframes.

44383 Some computational aspects of three-dimensional transient solid dynamics. Taylor, L.M. (Applied Mechanics Div. III, Sandia National Lab., Albuquerque, NM (US)); Flanagan, D.P. vp. of Advanced topics in finite element analysis. Cory, J.F.; Gordon, J.L. American Society of Mechanical Engineers, New York, NY (1988). (CONF-8806216–: Advanced topics in finite element analysis, 19-23 Jun 1988).

Many transient dynamic analysis programs employ explicit time integration with a lumped (diagnolized) mass matrix. These programs predict the response of solids to intense dynamic loads, such as crash, penetration, or explosive loads. The explicit integration architecture avoids the solution of coupled matrix equations, which is of great advantage in these highly nonlinear problems. Explicit integration algorithms are naturally well suited to both vector and concurrent processing. However, to realize the advantage of concurrent vector processors, many traditional schemes for managing finite element data in memory must be changed. Optimal performance requires vectorization of as much codes as possible; one cannot afford to sacrifice vectorization for concurrency.

44384 Considerations involved in the display of finite element results using animation. Gwinn, K.W. (Applied Mechanics Dept., Sandia National Labs., Albuquerque, NM (US)); Koteras, J.R. vp. of Advanced topics in finite element analysis. Cory, J.F.; Gordon, J.L. American Society of Mechanical Engineers, New York, NY (1988). (CONF-8806216–: Advanced topics in finite element analysis, 19-23 Jun 1988).

The use of high-end graphics device is one useful means of interpreting the complex results from numerical analyses. Generation of animation sequences is another useful tool for examining results. In the past, movie film has served as the basis for generation of animation sequences. Processing and editing of film has proved to be a cumbersome process. Video is an alternative which eliminates some of the problems of film. However, computer animation and video must be carefully integrated if the high quality of the computer animation is to be preserved. This paper discusses the various considerations which must be made when video is used as a basis for generation of animation sequences for numerical analyses.

44385 Using Linda for supercomputing on a local area network. Whiteside, R.A. (Dept. of Computer Science, Yale Univ., P.O. Box 2158 Yale Station, New Haven, CT (US)); Leichter, J.S. pp. 460 of Proceedings of IEEE supercomputing '88. IEEE Service Center, Piscataway, NJ (1988). (CONF-881112–: IEEE supercomputing '88, Orlando, FL (USA), 14-18 Nov 1988).

A distributed parallel processing system based on the Linda programming constructs has been implemented on a local area network of computers. This system allows a single application program to utilize many machines on the network simultaneously. Several applications have been implemented on the network at Sandia National Laboratories and have achieved performances considerably faster than that of a Cray-1S. Several collections of machines have been used including up to eleven DEC VAXes, three Sun/3 workstations, and a PC.

44386 Profiles in mass storage. Collins, B. (Computing and Communications Div., Los Alamos National Lab., Los Alamos, NM (US)); Devaney, M.; Kitts, D. pp. 460 of Proceedings of IEEE supercomputing '88. IEEE Service Center, Piscataway, NJ (1988). (CONF-881112–: IEEE supercomputing '88, Orlando, FL (USA), 14-18 Nov 1988).

The Los Alamos Common File System (CFS) and the NCAR Mass Storage System (MSS) are file storage and file management systems that serve heterogeneous computing networks of supercomputers, general purpose computers, scientific workstations and personal computers. This paper details philosophical, implementation and performance aspects of the two mass storage systems. Areas covered include the computing environment, the user interface, storage strategies and file movement strategies.

44387 The birth of the second generation. Eoyang, C. (Institute for Supercomputing Research, 8F Recruit Kachidoki Bldg., 2-11 Kachidoki, Chuo-ku, Tokyo (JP)); Mendez, R.H.; Lubeck, O.M. pp. 460 of Proceedings of IEEE supercomputing '88. IEEE Service Center, Piscataway, NJ (1988). (CONF-881112–: IEEE supercomputing '88, Orlando, FL (USA), 14-18 Nov 1988).

A performance evaluation and comparison of the new Hitachi S-820/80 supercomputer on a set of standard Fortran benchmark codes which range from simple kernels to fluid dynamics applications.

44388 Performance comparison of the CRAY-2 and CRAY X-MP/416 supercomputers. Simmons, M.L. (Computing and Communications Div., Group C-3, MS B265, P.O. Box 1663, Los Alamos National Lab., Los Alamos, NM (US)); Wasserman, H.J. pp. 460 of Proceedings of IEEE supercomputing '88. IEEE Service Center, Piscataway, NJ (1988). (CONF-881112–: IEEE supercomputing '88, Orlando, FL (USA), 14-18 Nov 1988).

The serial and parallel performance of one of the world's fastest general purpose computers, the CRAY-2, is analyzed using the standard Los Alamos Benchmark Set plus codes adopted for parallel processing. For comparison, architectural and performance data are also given for the CRAY X-MP/416. Factors affecting performance, such as memory bandwidth, size and access speed of memory, and software exploitation of hardware, are examined. The parallel processing environments of both machines are evaluated, and speed-up measurements for the parallel codes are given.

44389 Expert systems application for diagnosis and troubleshooting of computer systems and instrumentation. Carr, K.R. (Oak Ridge National Lab., Oak Ridge, TN (US)). vp. of Proceedings of the ISA/86 international conference and exhibit. Instrument Society of America, Research Triangle Park, NC (1986). (CONF-861039–: Instrument Society of America international conference and exhibit, 13-16 Oct 1986).

In some instances, a computer program that simulates human decision making in a specified area of knowledge, called an expert system, can be an appropriate and powerful tool to facilitate diagnosis and troubleshooting of computer systems and instrumentation. However, a determination of the advisability and usefulness of implementing an expert system for a particular application requires careful consideration and several factors. A project in progress of the U.S.. Navy to evaluate potential expert systems applications for hot-line troubleshooting support of geographically dispersed computer systems is described here. Even though conducted with an emphasis on specific types of equipment, the project developed methods and information generally applicable in the decision to implement an expert system as a troubleshooting aid for any type of computer or instrumentation equipment.

44390 A visualization model based on the mathematics of fiber bundles. Butler, D. M. (Limit Point Systems, 39120 Argonaut Way, Suite 397, Fremont, California 94538 (US)); Pendley, M. H. *Computers in Physics (USA),* 3(5): 45-51 (Sep 1989). DOE Contract AC04-76DP00789.

In this paper, a visualization model based on the mathematics of fiber bundles is described. A brief, intuitive description of the mathematics of fiber bundles is given, introducing the concepts using typical application examples and emphasizing aspects relevant to our visualization model. Three important classes of operations on fiber bundles are described. A flexible scheme is developed for constructing graphic representations of fiber bundles and a simple but useful visualization taxonomy.

44391 The visualization management system approach to visualization in scientific computing. Butler, D. M. (Limit Point Systems, 39120 Argonaut Way, Suite 397, Fremont, California 94538 (US)); Pendley, M. H. *Computers in Physics (USA),* 3(5): 40-44 (Sep 1989). DOE Contract AC04-76DP00789.

This paper introduces the visualization management system (ViMS), a new approach to the development of software for visualization in scientific computing (ViSC). The conceptual foundation for a ViMS is an abstract visualization model that specifies a class of geometric objects, the graphic representations of the objects, and the operations on both. A ViMS implements a visualization model and provides four levels of mechanisms for developing applications. The ViMS requirements and a model-independent ViMS architecture are described. The ViMS approach presents several important opportunities for visualization standards.

44392 Higher order Godunov methods for general systems of hyperbolic conservation laws. Bell, J. B. (Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94550 (US)); Colella, P.; Trangenstein, J. A. *Journal of Computational Physics (USA),* 82(2): 362-397 (Jun 1989). DOE Contract W-7405-ENG-48.

We describe an extension of higher order Godunov methods to general systems of hyperbolic conservation laws. This extension allow the method to be applied to problems that are not strictly hyperbolic and exhibit local linear degeneracies in the wave fields. The method constructs an approximation of the Riemann problem from local wave information. A generalization of the Engquist–Osher flux for systems is then used to compute a numerical flux based on this approximation. This numerical flux replaces the Godunov numerical flux in the algorithm, thereby eliminating the need for a global Riemann problem solution. The additional modifications to the Godunov methodology that are needed to treat loss of strict hyperbolicity are described in detail. THe method is applied to some simple model problems for which the glocal analytic structure is known. The method is also applied to the black-oil model for multiphase flow in petroleum reservoirs. © 1989 Academic Press, Inc.

44393 Product representation for the harmonic series of a unit vector: A string application. Brown, R. W. (Physics Department, Case Western Reserve University, Cleveland, Ohio 44106 (US)); DeLaney, D. B. *Physical Review Letters (USA),* 63(5): 474-477 (31 Jul 1989).

We find a representation for the finite Fourier series of a vector whereby any constant constraint on its magnitude is completely solved and automatically satisfied. The representation is a product of rotations, one set for each harmonic, such that the independent degrees of freedom are identified as rotational angles and an infinite series is replaced by an infinite product. This can be applied to the study of relativistic strings, and other applications and generalizations are anticipated.

44394 Consistent finite difference operators that satisfy $\nabla \cdot \nabla \times \equiv 0$. Caramana, E. J. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545 (US)). *Journal of Computational Physics (USA),* 82(2): 492-498 (Jun 1989).

Faraday's law of electromagnetism is solved in cylindrical coordinates. (AIP)

44395 The second-order sharpening of blurred smooth borders. Swartz, B. (Theoretical Division, MS B284 University of California Los Alamos National Laboratory Los Alamos, New Mexico 87545(US)). *Mathematics of Computation (USA),* 52(186): 675-714 (Apr 1989). DOE Contract W-7405-ENG-36.

The problem is to approximate, with local second-order accuracy, the smooth boundary separating a black and a white region in the plane, given discretely located gray values associated with a blurring of that border. "Second-order", here, is with respect to the size *h* of the scale of the prescribed blurring. The locally determined approximations are line segments. The algorithms discussed here can result in second-order accuracy, but they may not in certain geometric circumstances. Typical local curvature estimates based on adjacent line segments do not converge, but atypical one does. Consideration of a class of scaled blurrings leads to a type of blurring of borders which is particularly easy for a computer to undo locally, yielding a line which is locally second-order accurate. Some extensions to three (and more) dimensions are appended.

44396 Oblique derivative boundary conditions and the image method for wedges. Gautesen, A.K. (0305000). *SIAM Journal on Applied Mathematics (USA),* 48(6): 1487-1492 (Dec 1988).

The image method of solving boundary value problems in half spaces with oblique derivative boundary conditions for a class of equations including the wave equation, the heat equation and Laplace's equation is extended to spaces whose boundaries are formed by two intersecting planes with angle of intersection π/N.

9903 Information Handling

Refer also to citation(s) 42334, 42335, 42336, 43005, 44347, 44352

44397 (INDC(SEC)–097/UN) INDC list of correspondents for the exchange of nuclear data information and compilation of national nuclear data committees. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. May 1989. 125p. Order Number DE89635660/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

This list supersedes INDC(SEC)-93/UN.

The document includes information on currently existing National Nuclear Data Committees and their memberships. It contains five sections. The first section contains a detailed description of the INDC distribution categories, distribution codes and document designator codes. The second section describes the aims, organization and objectives of individual national nuclear data committees. The third section lists names and addresses in alphabetical order within each state or international organization together with the assigned INDC document distribution code(s). This is followed by four shorter lists, indicating the names of individuals in each distribution category, sorted by country or international organization, and the total number of individuals in each category. The final section provides the names of nuclear data committee members also listed by country or international organization.

44398 (INDC(SEC)–098/UN) **List of documents received by the INDC Secretariat.** International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. May 1989. 30p. Order Number DE89635668/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This list supersedes INDC(SEC)-094/UN.

The Nuclear Data Section of the IAEA receives documents originated by or for the International Nuclear Data Committee for distribution. This list includes all INDC documents received and distributed by the INDC Secretariat during the period September 1987 to February 1989. The list is produced directly from computer printouts into two groups: one ordered by accession number, and the other ordered by document number within each series. The document lists also in an Appendix the titles of reports received as single copies for information.

44399 (INIS-mf–11503, pp. 110-114) **Quality evaluation criteria for information extraction.** Ingman, D. (Technion-Israel Inst. of Tech., Haifa (Israel). Dept. of Nuclear Engineering); Merlis, Y. Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, Beer-Sheva (Israel), 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

Analysis and processing of the measured data have many applications in many different fields. Some of the applications in nuclear engineering demand very high confidence level and therefore there is a need of reliable tools for data analysis. In this paper we introduce three data quality evaluation criteria: a. Parametric uncertainty, b. 'Reconstruction noise' autocorrelation, c. Moment analysis. The criteria of information examination can be used as powerful tools of analysis of the measured and processed data.

44400 (JAERI-M–89-015) **Experimental database retrieval system 'DARTS'. Handling manual.** Aoyagi, Tetsuo; Tani, Keiji; Haginoya, Hirobumi; Naito, Shinjiro. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1989. 96p. (In Japanese). Order Number DE89906473/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

In JT-60, a large tokamak device of Japan Atomic Energy Research Institute (JAERI), a plasma is fired for 5 ~ 10 seconds at intervals of about 10 minutes. The each firing is called a shot. Plasma diagnostic data are edited as JT-60 experimental database at every shot cycle and are stored in a large-scale computer (FACOM-M780). Experimentalists look up the data for specific shots which they want to analyze and consider. As the total number of shots increases, they find a difficulty in the looking-up work. In order that they can easily access to their objective shot data or shot group data by using a computer terminal, 'DARTS' (DAtabase ReTrieval System) has been developed. This report may provide enough information on DARTS handling for users. (author).

44401 (PNL–6928) **Testing Systems Database administrator guide.** Corrigan, A.L.; Olander, M. Pacific Northwest Lab., Richland, WA (USA). May 1989. 56p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-76RL01830. (TD–2699). Order Number DE89016241/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The Pacific Northwest Laboratory (PNL) was contracted by the Navy Personnel Research and Development Center (NPRDC) to provide software for enhancing the NPRDC CAMP Facility. The objectives of this Database Administrator Guide are to provide the Database Administrator with guidelines for the following tasks: installing the databases software, creating the TSD databases, managing database user accounts and access levels, compiling PRO*C and PRO*FORTRAN source code, creating new CRT definitions and maintaining the TSD database.

44402 (PNL–6929) **Testing systems database Program Maintenance Manual for PNL-developed software systems.** Caplinger, J.T.; Olander, M. Pacific Northwest Lab., Richland, WA (USA). May 1989. 592p. Sponsored by DOD;DOE/DP. DOE Contract AC06-76RL01830. (TD–2699). Order Number DE89016247/JAW. Available from NTIS, PC A25/MF A01 - OSTI; GPO Dep.

The Pacific Northwest Laboratory (PNL) has developed software for enhancing the Navy Personnel Research and Development Center (NPRDC) CAMP Facility. This software was developed for NPRDC under Contract AC06-76RLO1830. The objective of this Program Maintenance Manual is to provide the maintenance programmer personnel with the information necessary to effectively maintain the software system.

44403 (SAND–89-1869C) **A new bound for the authentication channel when used in the notary mode.** Simmons, G.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 21p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8908103–1: 4. joint Swedish/Soviet international workshop on information theory, Gutland (Sweden), 27 Aug - 1 sep 1989). Order Number DE89015848/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Authentication codes have traditionally been designed to only protect the receiver from accepting as authentic either fraudulent messages sent by an opponent when no legitimate message has been sent or else a fraudulent message substituted for the first legitimate message sent by an authorized transmitter. Clearly, an opponent might choose instead to wait and observe several legitimate (authenticated) messages before attempting to deceive the receiver. In this paper, we treat a "worst case" scenario in which the opponent can not only observe several authenticated messages before attempting a deception but he can also choose the information that is to be authenticated in the communications that occur before he acts. 15 refs.

9905 Civilian Defense

Refer also to citation(s) 42245, 42937, 43601

44404 (AD-A–206885/6/XAB) **SDI (Strategic Defense Initiative) Battle Management/C3 (Command, Control, and Communications) networking technology program plan. Final report, January 1987-October 1988.** Botta, R.; Noll, S. Institute for Defense Analyses, Alexandria, VA (USA). Dec 1988. 163p. (IDA-M–305). Available from NTIS, PC A08/MF A01.

The Institute for Defense Analyses (IDA) has collected and analyzed information on network technology that is relevant to Battle Management Command, Control, and Communications (BM/C3). This memorandum report represents a program plan that will provide the SDIO BM C3 directorate with administrative and technical insight into network technology. This program plan focuses on C3 network concepts and provides information and analysis to the SDIO to be used in formulating budget requirements for FY 1988 and beyond. Based upon analysis of network requirements and ongoing programs, recommendations have been made for research areas that should be funded, including both the continuation of current work and the initiation of new tasks. While emphasis here is on the SDIO-funded tasks, other relevant government-sponsored and commercial efforts, such as packet radio networks, also have been examined.

44405 (AD-A–207169/4/XAB) **Some issues in emergency management. Public views in 1987. Final report, August-December 1987.** Nehnevajsa, J. Pittsburgh Univ., PA (USA). Univ. Center for Social and Urban Research. Dec 1987. 182p. Available from NTIS, PC A09/MF A01.

This report presents an overview of findings, derived from a 1987 national telephone survey, on current public sentiment as it relates to numerous crucial civil defense issues and concerns. A primary objective is to provide empirically based insight into some of the common arguments, presented as reflecting public attitudes and perceptions, that must be evaluated as decisions on complex national policy alternatives are weighed. Emergency planning and preparedness measures, in place or considered for future implementation, that address the threat of national disasters, technological hazards, and particularly those relevant to the threat of a nuclear confrontation are explored. The public's perception of what the principal goals of civil defense should be is questioned. Their acceptance of a nuclear attack as a credible threat is assessed, as well as their estimates of probable survival rates under a variety of passive defense conditions. The perceived viability and value of alternative civil-defense measures and the public's expectations regarding governmental responsibility for implementing such measures are explored. Willingness to finance such measures or to reallocate existing funds to civil defense efforts is reported as another indication of support. The acceptability of crisis relocation is evaluated through inquiries into the public's support for the development of a national relocation plan, their intentions to evacuate when threatened, either spontaneously or in compliance to a Presidential directive and their expectations of such a directive becoming a reality.

44406 (DOE/SF/16495–T2) **Stimulated rotational Raman scattering: Final report, September 1, 1986–March 31, 1989.** Parazzoli, C.G.; Rafanelli, G.L.; Capps, D.M.; Drutman, C. Hughes Aircraft Co., El Segundo, CA (USA). Electro-Optical and Data Systems Group. 31 Mar 1989. 230p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC03-86SF16495. Order Number DE89016427/JAW. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

This document summarizes the work performed on DOE Contract Number AC03-86SF16495 by the Electro-Optics And Data Systems Group of Hughes Aircraft Company. The goal of this Stimulated Rotational Raman Scattering (SRRS) processes on high energy laser directed energy weapon systems. The program had three main objectives; achieving an accurate description of the physical processes involved in SRRS; developing a numerical algorithm to confidently evaluate SRRS-induced losses in the propagation of high energy laser beams in the uplink and downlink segments of the optical trains of various strategic defense system scenarios; and discovering possible methods to eliminate, or at least reduce, the deleterious effects of SRRS on the energy deposition on target. This document describes the accomplishments of the DOE program and is divided into the following sections: The first section discusses the motivation for the accomplishments of the DOE program; then discussed is the Semiclassical Theory Of Non-Resonant SRRS For Diatomic Homonuclear Molecules; and then the following appendices; Calculation of the Dipole Transition Reduced Matrix Element, Guided Tour of Hughes SRRS Code, Running the Hughes SRRS Code, and Hughes SRRS Code Listing.

Corporate Author Index

This index lists the corporate authors responsible for issuing the documents in this publication which are identified primarily by report number. The corporate names are entered in standardized forms as defined in *DOE Energy Data Base: Corporate Author Entries* (DOE/TIC-4585). Each entry under a corporate name includes the document title and citation number. Three items of information may appear in parentheses: (1) an abbreviation to identify the document type, such as a report; (2) the country of publication, also abbreviated; and (3) the language of the document if non-English (R;US;In French). Author affiliations are not listed in this index.

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FG02-87ER40335	Colorado Univ., Boulder, CO (USA). Dept. of Physics	
	14:43939	DOE/ER/40335–4
FG02-87ER45333	Temple Univ., Philadelphia, PA (USA). Dept. of Physics	
	14:44043	DOE/ER/45333–2
FG02-87ER53244	Colorado Univ., Boulder, CO (USA). Dept. of Chemistry	
	14:44192	DOE/ER/53244–10
FG02-87ER60531	Colorado State Univ., Fort Collins, CO (USA)	
	14:43597	DOE/ER/60531–1
FG02-88CE90025	Michigan Univ., Ann Arbor, MI (USA). W.E. Lay Automotive Lab.	
	14:42400	DOE/CE/90025–1
FG02-88ER13930	Syracuse Univ., NY (USA). Dept. of Chemical Engineering and Materials Science	
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FG02-88ER40387	Ohio Univ., Athens, OH (USA)	
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FG02-88ER45376	Rochester Univ., NY (USA). Lab. for Laser Energetics	
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FG03-85ER13393	Stanford Univ., CA (USA). Dept. of Mechanical Engineering	
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	14:42776	Published article
FG05-86ER60473	Florida State Univ., Tallahassee, FL (USA). Inst. of Molecular Biophysics	
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FG05-87ER13730	Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (USA). Dept. of Anaerobic Microbiology	
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FG05-87ER40309	Rice Univ., Houston, TX (USA). Dept. of Physics	
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FG05-87ER60575	Duke Univ., Durham, NC (USA). Dept. of Botany	
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FG05-88ER13950	North Carolina Univ., Chapel Hill, NC (USA). Dept. of Chemistry	
	14:42714	DOE/ER/13950–1
FG05-88ER40390	Virginia Univ., Charlottesville, VA (USA). Dept. of Physics	
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FG05-88ER40455	University of North Texas, Denton, TX (USA)	
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FG05-88ER53266	Texas Univ., Austin, TX (USA). Fusion Research Center	
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FG05-88ER60685	Florida State Univ., Tallahassee, FL (USA). Dept. of Biological Science	
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FG05-88ER69010	Duke Univ., Durham, NC (USA). Dept. of Botany	
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FG09-84ER13188	Georgia Univ., Athens, GA (USA). Dept. of Botany	
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FG09-85ER13426	Georgia Univ., Athens, GA (USA). Complex Carbohydrate Research Center	
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FG09-87ER13709	Georgia Univ., Athens, GA (USA). Research Foundation	
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FG22-83PC60797	Southern Illinois Univ., Carbondale, IL (USA). Dept. of Mechanical Engineering and Energy Processes	
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FG22-86PC90510	Stanford Univ., CA (USA). Dept. of Chemical Engineering	
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FG22-86PC90518	Princeton Univ., NJ (USA). Dept. of Chemical Engineering	
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FG22-87PC79806	Michigan Technological Univ., Houghton, MI (USA). Dept. of Chemistry and Chemical Engineering	
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8805	14:42302	Alberta Municipal Affairs, Jarvis Bldg., 6th Floor, 9925-107 St., Edmonton, AB, CAN T5K 2H9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
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8701	14:42236	Association of Canadian Universities for Northern Studies, 130 Albert Street, Ottawa, ON, CAN K1P 5G4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
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206284/2/XAB	14:44345	NTIS, PC A03/MF A01			ND-00
206285/9/XAB	14:42341	NTIS, PC A13/MF A01			ND-00
206290/9/XAB	14:43659	NTIS, PC A04/MF A01			ND-00
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206295/8/XAB	14:43468	NTIS, PC A03/MF A01			ND-00
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206321/2/XAB	14:43341	NTIS, PC A08/MF A01			ND-00
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206456/6/XAB	14:42303	NTIS, PC A04/MF A01			ND-00
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206481/4/XAB	14:44148	NTIS, PC A02/MF A01			ND-00
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206666/0/XAB	14:43721	NTIS, PC A02/MF A01			ND-00
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206792/4/XAB	14:41548	NTIS, PC A03/MF A01			ND-00
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206808/8/XAB	14:41836	NTIS, PC A03/MF A01			ND-00
206811/2/XAB	14:42579	NTIS, PC A03/MF A01			ND-00
206816/1/XAB	14:43746	NTIS, PC A03/MF A01			ND-00
206819/5/XAB	14:43747	NTIS, PC A03/MF A01			ND-00
206821/1/XAB	14:43748	NTIS, PC A05/MF A01			ND-00
206833/6/XAB	14:43757	NTIS, PC A03/MF A01			ND-00
206839/3/XAB	14:42895	NTIS, PC A03/MF A01			ND-00

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
206849/2/XAB	14:42493	NTIS, PC A03/MF A01			ND-00
206852/6/XAB	14:44349	NTIS, PC A05/MF A01			ND-00
206860/9/XAB	14:44350	NTIS, PC A03/MF A01			ND-00
206880/7/XAB	14:43749	NTIS, PC A02/MF A01			ND-00
206881/5/XAB	14:43750	NTIS, PC A03/MF A01			ND-00
206885/6/XAB	14:44404	NTIS, PC A08/MF A01			ND-00
206908/6/XAB	14:44246	NTIS, PC A02/MF A01			ND-00
206911/0/XAB	14:44351	NTIS, PC A03/MF A01			ND-00
206923/5/XAB	14:43662	NTIS, PC A03/MF A01			ND-00
206929/2/XAB	14:43424	NTIS, PC A12/MF A01			ND-00
206932/6/XAB	14:42580	NTIS, PC A02/MF A01			ND-00
206936/7/XAB	14:43758	NTIS, PC A05/MF A01			ND-00
206944/1/XAB	14:42245	NTIS, PC A16/MF A01			ND-00
206949/0/XAB	14:43028	NTIS, PC A03/MF A01			ND-00
206952/4/XAB	14:43316	NTIS, PC A06/MF A01			ND-00
206957/3/XAB	14:43483	NTIS, PC A16/MF A01			ND-00
206960/7/XAB	14:43547	NTIS, PC A99/MF E04			ND-00
206970/6/XAB	14:42494	NTIS, PC A03/MF A01			ND-00
206971/4/XAB	14:43317	NTIS, PC A04/MF A01			ND-00
206976/3/XAB	14:43629	NTIS, PC A07/MF A01			ND-00
206979/7/XAB	14:43690	NTIS, PC A06/MF A01			ND-00
206987/0/XAB	14:43759	NTIS, PC A05/MF A01			ND-00
207003/5/XAB	14:42896	NTIS, PC A03/MF A01			ND-00
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207036/5/XAB	14:43751	NTIS, PC A04/MF A01			ND-00
207039/9/XAB	14:42798	NTIS, PC A03/MF A01			ND-00
207045/6/XAB	14:43484	NTIS, PC A04/MF A01			ND-00
207046/4/XAB	14:43691	NTIS, PC A04/MF A01			ND-00
207052/2/XAB	14:42937	NTIS, PC A06/MF A01			ND-00
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207063/9/XAB	14:42581	NTIS, PC A02/MF A01			ND-00
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207102/5/XAB	14:42382	NTIS, PC A06/MF A01			ND-00
207114/0/XAB	14:42938	NTIS, PC A03/MF A01			ND-00
207117/3/XAB	14:42437	NTIS, PC A03/MF A01			ND-00
207119/9/XAB	14:42199	NTIS, PC A06/MF A01			ND-00
207134/8/XAB	14:42939	NTIS, PC A02/MF A01			ND-00
207135/5/XAB	14:42940	NTIS, PC A03/MF A01			ND-00
207150/4/XAB	14:43752	NTIS, PC A03/MF A01			ND-00
207169/4/XAB	14:44405	NTIS, PC A09/MF A01			ND-00
207174/4/XAB	14:42905	NTIS, PC A03/MF A01			ND-00
955412/2/XAB	14:43318	NTIS, PC A03/MF A01			ND-00
955415/5/XAB	14:43319	NTIS, PC A08/MF A01			ND-00
955418/9/XAB	14:43320	NTIS, PC A04/MF A01			ND-00
ADI–					
1989	14:41837	New Brunswick Dept. of Natural Resources and Energy, P.O. Box 6000, Fredericton, NB, CAN E3B 5H1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
AE-TLA–					
51E5-VOL-1	14:43479	*See* AD-A–206274/3/XAB			
AEC–					
87-18-RR2	14:42384	Environment Council of Alberta, 8th Floor, Weber Centre, 5555 Calgary Trail, Edmonton, AB, CAN T6H 5P9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
87-18/RR1	14:42383	Environment Council of Alberta, 8th Floor, Weber Centre, 5555 Calgary Trail, Edmonton, AB, CAN T6H 5P9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
89	14:41555	Alberta Energy Company Ltd., 1200, 10707-100 Avenue, Edmonton, AB, CAN T5J 3M1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
AECL–					
8367	14:41693	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89635606/JAW	MF-000
8392	14:42438	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89634929/JAW	MF-000
8394	14:41694	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89635608/JAW	MF-000
8399	14:41988	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635528/JAW	MF-000
8400	14:41989	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635529/JAW	MF-000
8405	14:44247	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89634483/JAW	MF-000
8848	14:44335	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89635688/JAW	MF-000
8961	14:41990	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635531/JAW	MF-000
9062	14:43579	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89635240/JAW	MF-000
9064	14:41695	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635610/JAW	MF-000
9065	14:41785	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89635409/JAW	MF-000
9073	14:42709	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89634755/JAW	MF-000
9075	14:41696	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89635611/JAW	MF-000
9077	14:41691	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635420/JAW	MF-000
9081	14:43580	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635241/JAW	MF-000
9082	14:41697	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635113/JAW	MF-000
9087	14:42496	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635024/JAW	MF-000
9088	14:42439	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635532/JAW	MF-000
9089	14:42799	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89634904/JAW	MF-000
9090	14:42994	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635439/JAW	MF-000
9091	14:41698	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635114/JAW	MF-000
9094	14:42078	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635466/JAW	MF-000
9097	14:42079	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635669/JAW	MF-000
9098	14:42080	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635670/JAW	MF-000
9099	14:42081	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635671/JAW	MF-000
9107	14:41991	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635533/JAW	MF-000
9184	14:42071	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635563/JAW	MF-000
9185	14:44003	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634618/JAW	MF-000
9186	14:42995	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635440/JAW	MF-000
9194	14:41992	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635535/JAW	MF-000
9202	14:42050	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635484/JAW	MF-000
9252	14:41800	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635421/JAW	MF-000
9258	14:42996	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635441/JAW	MF-000
9260	14:41993	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635536/JAW	MF-000
9264	14:41786	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635399/JAW	MF-000
9334S	14:41980	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635523/JAW	MF-000
9338	14:42953	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635416/JAW	MF-000
9341	14:43166	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635583/JAW	MF-000
9382	14:42440	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634992/JAW	MF-000
9384	14:42497	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635032/JAW	MF-000
9386	14:42441	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634958/JAW	MF-000
9389	14:44248	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634492/JAW	MF-000
9421	14:41994	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635540/JAW	MF-000
9431	14:43094	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635435/JAW	MF-000
9437	14:42498	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635042/JAW	MF-000
9441	14:41699	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635612/JAW	MF-000
9501	14:43042	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635425/JAW	MF-000
9502	14:43760	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633965/JAW	MF-000
9506	14:43506	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635118/JAW	MF-000
9507	14:43412	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635132/JAW	MF-000
9514	14:41995	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635542/JAW	MF-000
9519	14:43095	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635436/JAW	MF-000
9520	14:43507	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89635119/JAW	MF-000
9521	14:43508	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89635120/JAW	MF-000
9522	14:43258	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635596/JAW	MF-000
9610	14:43440	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635084/JAW	MF-000
9681	14:44336	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89620467/JAW	MF-000
AERE-G–					
5002	14:41700	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635601/JAW	MF-000
AERE-M–					
3736	14:43167	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635585/JAW	MF-000
AERE-R–					
13019	14:42582	H.M. Stationery Office, London, price Pound 12.00			ND-000
13025	14:43449	*See* NSS/R–121			
13110	14:41921	United Kingdom Atomic Energy Authority, Harwell. Environmental and Medical Sciences Division			ND-000
AEROCHEM-TP–					
482	14:42894	*See* AD-A–206693/4/XAB			
AFGL-TR–					
88-0034	14:43740	*See* AD-A–205976/4/XAB			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
88-0250	14:43741	*See* AD-A–206062/2/XAB			
88-0253	14:43738	*See* AD-A–205703/2/XAB			
89-0047	14:43708	*See* AD-A–205324/7/XAB			
89-0049	14:43713	*See* AD-A–205762/8/XAB			
89-0051	14:43714	*See* AD-A–205763/6/XAB			
89-0052	14:43715	*See* AD-A–205764/4/XAB			
89-0053	14:43710	*See* AD-A–205384/1/XAB			
89-0055	14:43721	*See* AD-A–206666/0/XAB			
89-0056	14:43711	*See* AD-A–205538/2/XAB			
89-0057	14:43717	*See* AD-A–205766/9/XAB			
89-0058	14:43718	*See* AD-A–205767/7/XAB			
89-0059	14:43716	*See* AD-A–205765/1/XAB			
89-0060	14:43709	*See* AD-A–205326/2/XAB			
89-0082	14:43757	*See* AD-A–206833/6/XAB			
89-0083	14:43323	*See* AD-A–206236/2/XAB			
AFIT/DS/ENP–					
88-2	14:42578	*See* AD-A–206160/4/XAB			
AFIT/GCS/ENG–					
88D-11	14:44343	*See* AD-A–206046/5/XAB			
89M-2	14:43309	*See* AD-A–206094/5/XAB			
AFIT/GNE/ENP–					
89M-1	14:44171	*See* AD-A–206158/8/XAB			
89M-3	14:43312	*See* AD-A–206355/0/XAB			
89M-4	14:42903	*See* AD-A–206092/9/XAB			
89M-6	14:43308	*See* AD-A–206093/7/XAB			
AFIT/GOR/MA–					
88D-2	14:43627	*See* AD-A–206082/0/XAB			
AFRRI-SR–					
88-38	14:43589	*See* AD-A–205806/3/XAB			
88-39	14:43588	*See* AD-A–205805/5/XAB			
88-40	14:43587	*See* AD-A–205804/8/XAB			
88-41	14:43586	*See* AD-A–205803/0/XAB			
88-42	14:43590	*See* AD-A–205807/1/XAB			
88-43	14:43594	*See* AD-A–205814/7/XAB			
88-44	14:43593	*See* AD-A–205813/9/XAB			
88-45	14:43592	*See* AD-A–205812/1/XAB			
88-46	14:43591	*See* AD-A–205810/5/XAB			
AI–					
84-15-1	14:42422	*See* PB–89-178792/XAB			
AMXTH-TR-TE–					
88242	14:43422	*See* AD-A–206240/4/XAB			
ANL-HEP-CP–					
89-19	14:43804	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015139/JAW	MF-414
ANL/EES-TM–					
376	14:44352	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014007/JAW	MF-000
AOSTRA–					
8808	14:41618	Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, CAN T5J 3L8; $150.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
ARC/CR–					
1983	14:41420	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
34	14:41419	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
AU/EE–					
051983	14:44249	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
06041981	14:41865	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000

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AU/EE–					
U-79-11/80-14	14:42941	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
AU/ME–					
08-U-79-9	14:41873	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
59-65002	14:41518	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
U-79-9	14:41874	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
AU/P–					
8212	14:41881	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
U-30	14:41612	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
AV-FR–					
86/597	14:43364	*See* PB–89-174171/XAB			
BATT-TCN–					
87-116	14:43311	*See* AD-A–206265/1/XAB			
BBN–					
6741-VOL-1	14:43659	*See* AD-A–206290/9/XAB			
6742-VOL-2	14:43660	*See* AD-A–206291/7/XAB			
BCH/RD–					
030-D-173-Prt2	14:41931	Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
BCMEP–					
8704	14:43343	Western and Northern Canada acid deposition/LRTAP activities, 2nd. Fl., 4999-98th Ave., Edmonton, AB, CAN T6B 2X3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
8706	14:43344	British Columbia Ministry of Environment and Parks, Parliament Bldgs., Victoria, BC, CAN V8V 1X4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
BFLRF–					
217	14:41547	*See* AD-A–206053/1/XAB			
235	14:42397	*See* AD-A–205636/4/XAB			
248	14:42398	*See* AD-A–206054/9/XAB			
260	14:42414	*See* AD-A–205635/6/XAB			
BIOLOGICAL–					
85(1.17)	14:43646	*See* PB–89-187173/XAB			
89(1)	14:43550	*See* PB–89-178131/XAB			
BLP–					
8706	14:43345	Canada Mortgage and Housing Corporation, Annex Bldg., 628 Montreal Rd., Ottawa, ON, CAN K1A 0P7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
BMU–					
1989-208	14:42082	GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.)			ND-000

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1989-213	14:42083	GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.)			ND-000
BNL–					
42659	14:43666	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016124/JAW	MF-607
42947	14:43097	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016408/JAW	MF-414
42948	14:43906	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016413/JAW	MF-413
42954	14:43067	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015857/JAW	MF-414
42974	14:43898	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016410/JAW	MF-413
43033	14:44149	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016420/JAW	MF-414
43034	14:44150	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016421/JAW	MF-414
43065	14:44151	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016412/JAW	MF-404
43072	14:44152	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016411/JAW	MF-404
43121-CP	14:43560	Plenum Press, 233 Spring St., New York, NY 10013			ND-408
BNL-NUREG–					
51454-Vol.8-No.4	14:42128	*See* NUREG/CR–2331-Vol.8-No.4			
BNR–					
SD-180	14:41932	Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
BNWL-CC–					
167	14:43413	NTIS, PC A03/MF A01 - OSTI		DE89015086/JAW	MF-702
BIBoS–					
353/89	14:43858	Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS)			ND-000
354/89	14:44172	Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS)			ND-000
357/89	14:44173	Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS)			ND-000
358/89	14:43859	Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS)			ND-000
360/87	14:43860	Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS)			ND-000
C–					
981F	14:42494	*See* AD-A–206970/6/XAB			
CANMET–					
7-185-144	14:42442	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.			ND-000
82-00106	14:42583	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.			ND-000
84-11E	14:44021	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635402/JAW	MF-000
CANMET-R–					
85-4E	14:41636	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635107/JAW	MF-000
CE–					
02476	14:42173	*See* IREQ–7403			
02480	14:42287	*See* GQ/DGE–1975			
02620	14:41939	*See* IREQ–231D488			
02621	14:41954	*See* SPC–144T307			
02622	14:43673	*See* RVH–165D286			
02623	14:42589	*See* EXRC–634U577			
02624	14:41949	*See* OH/RD–199T425			
02625	14:43035	*See* WPLA–327G431			
02630	14:41938	*See* IREQ–183-T-357			
02631	14:42354	*See* IREQ–417-U-475			
02633	14:41932	*See* BNR–SD-180			
02636	14:41950	*See* OH/RD–208-D-455			
02638	14:41931	*See* BCH/RD–030-D-173-Prt2			
02654	14:42222	*See* EE–1988			
02655	14:43634	*See* FEARO–802			
02658	14:41618	*See* AOSTRA–8808			
02663	14:42377	*See* SHA–C-258			
02664	14:44188	*See* IREQ–7909			
02666	14:41419	*See* ARC/CR–34			
02667	14:41420	*See* ARC/CR–1983			

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02668	14:41518	*See* AU/ME–59-65002			
02669	14:41881	*See* AU/P–8212			
02670	14:44249	*See* AU/EE–051983			
02671	14:41873	*See* AU/ME–08-U-79-9			
02672	14:41874	*See* AU/ME–U-79-9			
02673	14:41612	*See* AU/P–U-30			
02675	14:41504	*See* EMR–84-03			
02677	14:43037	*See* COGLA–8702A			
02678	14:43036	*See* COGLA–8702			
02679	14:43038	*See* DNV/C–48SZ23304-6-5006			
02680	14:41555	*See* AEC–89			
02682	14:43024	*See* WCWS–8309			
02683	14:43027	*See* WCWS–8409			
02684	14:41835	*See* SFWE–1989			
02685	14:42941	*See* AU/EE–U-79-11/80-14			
02687	14:41609	*See* NEB–MH-2-88			
02688	14:41599	*See* NEB–GH-5-88-F			
02689	14:41610	*See* NEB–MH-2-88-F			
02690	14:41598	*See* NEB–GH-5-88			
02695	14:41940	*See* MHVDC–288-T-586			
02696	14:41933	*See* CEA/RD–259-T-702			
02697	14:41826	*See* MH–722-G626			
02698	14:43433	*See* CSC–143-G-299			
02699	14:41607	*See* NEB–GH-3-89			
02700	14:41608	*See* NEB-SS–GH-3-89-F			
02701	14:41937	*See* IREQ–004D458			
02702	14:43353	*See* GKYA–7224DD67			
02703	14:43404	*See* SBM–8308			
02704	14:43400	*See* PW–8805			
02706	14:42267	*See* NEB-SS–EH-1-89			
02707	14:43403	*See* PW–602031			
02708	14:43402	*See* PW–8806-5			
02709	14:43401	*See* PW–8806-4			
02710	14:43450	*See* ORF–P-5340/FG			
02711	14:43029	*See* CMHC–8707			
02712	14:43033	*See* SC–8708			
02713	14:43345	*See* BLP–8706			
02729	14:43346	*See* CMHC–8703			
02731	14:41865	*See* AU/EE–06041981			
CEA-CONF–					
9689	14:44250	NTIS (US Sales Only), PC A02/MF A01		DE89903177/JAW	MF-000
9744	14:42954	NTIS (US Sales Only), PC A03/MF A01		DE89903183/JAW	MF-000
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599	14:43692	NTIS (US Sales Only), PC A02/MF A01		DE89908185/JAW	MF-000
600	14:43693	NTIS (US Sales Only), PC A02/MF A01		DE89908184/JAW	MF-000
601	14:43694	NTIS (US Sales Only), PC A02/MF A01		DE89908183/JAW	MF-000
CEA-R–					
5473	14:43441	NTIS (US Sales Only), PC A10/MF A01		DE89908104/JAW	MF-000
5484	14:43414	NTIS (US Sales Only), PC A11/MF A01		DE89908155/JAW	MF-000
CEA/RD–					
259-T-702	14:41933	Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
CERI–					
89-11	14:43457	*See* PB–89-169205/XAB			
CERL-E–					
89/05	14:43028	*See* AD-A–206949/0/XAB			
CERN–					
89-06	14:44353	NTIS (US Sales Only), PC A21/MF A01 - OSTI; INIS		DE89633843/JAW	MF-000

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CES/MA–					
170	14:42343	Maritimes Forestry Centre, Forestry Canada, P.O. Box 4000, MacKay Dr., Fredericton, NB, CAN E3B 5P7; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
CFFTP-B–					
86017	14:44251	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634455/JAW	MF-000
86019	14:44252	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634494/JAW	MF-000
CFFTP-G–					
86040	14:44253	NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS		DE89634456/JAW	MF-000
87011	14:41782	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635397/JAW	MF-000
CLM-R–					
285	14:42040	H.M. Stationery Office, London, price Pound 8.00			ND-000
CMHC–					
8703	14:43346	Canada Mortgage and Housing Corporation, Annex Bldg., 628 Montreal Rd., Ottawa, ON, CAN K1A 0P7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
8707	14:43029	Canada Mortgage and Housing Corporation, Annex Bldg., 628 Montreal Rd., Ottawa, ON, CAN K1A 0P7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
CNEA-D-Q–					
6	14:44337	*See* CNEA-NT–41/87			
CNEA-NT–					
41/87	14:44337	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89620468/JAW	MF-000
COGLA–					
8702	14:43036	Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
8702A	14:43037	Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
CONF-7403113–		(Stockage de l'energie; Varennes (Canada); 20 Mar 1974)			
	14:42173	*See* IREQ–7403			
CONF-8309416–		(Western Canada water and sewage conference; 21-23 Sep 1983)			
	14:43024	*See* WCWS–8309			
CONF-8409417–		(Western Canada water and sewage conference; Calgary (Canada); 19-21 Sep 1984)			
	14:43027	*See* WCWS–8409			
CONF-850302–		(8. international conference on fluidized bed combustion; Houston, TX (USA); 18-21 Mar 1985)			
4	14:41488	*See* STEV-FBT–89-1			
CONF-8508275–		(Joint German-Indonesian seminar on R and D activities using the MPR-30; Jakarta (Indonesia); 19-21 Aug 1985)			
	14:42248	*See* Juel-Conf–68			
CONF-8508276–		(Arctic heritage; Banff (Canada); 24-28 Aug 1985)			
	14:42236	*See* ACUNS–8701			
CONF-850905–		(ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling; Toronto (Canada); 22-26 Sep 1985)			
	14:42179	*See* ITL–8509			
	14:42180	*See* ITL–8509			
	14:42308	*See* ITL–8509			
CONF-8510489–		(98. annual meeting of the Geological Society of America; Orlando, FL (USA); 28-31 Oct 1985)			
	14:43703				
	14:43704				

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8511103–		(ICALEO international congress on the applications of lasers and electro-optics; San Francisco, CA (USA); 11-14 Nov 1985)			
6	14:42584	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015311/JAW	MF-406
CONF-851217–		(Materials Research Society meeting; 2-7 Dec 1985)			
	14:42520	Materials Research Society, 9800 Mc Knight Rd., Suite 327, Pittsburgh, PA 15237			
CONF-8601153–		(Experiences with offshore instrumentation; Geilo (Norway); 29-31 Jan 1986)			
	14:43039	*See* NEI-NO–90			
CONF-8605365–		(IEA AFBC workshop on FBC mathematical modelling; Vienna (Austria); 5 May 1986)			
1	14:41489	*See* STEV-FBT–89-3			
CONF-8605367–		(Canadian conference on industrial computer systems; 28 May 1986)			
	14:42050	*See* AECL–9202			
CONF-8605368–		(5. symposium on military engineering: electrochemical energy sources; 26-28 May 1986)			
	14:42200	NTIS (US Sales Only), PC A11/MF A01; NTIS (US Sales Only), PC A11		DE89910815/JAW	MF-000
CONF-860605–		(13. international symposium on the effects of radiation on materials; Seattle, WA (USA); 23-25 Jun 1986)			
	14:42471	ASTM, 1916 Race St., Philadelphia, PA 19103			
47	14:42452	*See* HEDL-SA–3564			
CONF-8606427–		(Symposium on advanced nuclear services; 11 Jun 1986)			
	14:41993	*See* AECL–9260			
CONF-860805–		(International heat transfer conference; 17-22 Aug 1986)			
	14:42953	*See* AECL–9338			
CONF-860906–		(American Nuclear Society topical meeting on advances in reactor physics and safety; 17-19 Sep 1986)			
	14:41992	*See* AECL–9194			
CONF-8610461–		(Joint German-Indonesian seminar on public acceptance, waste management, and nuclear safety; Jakarta (Indonesia); 7-9 Oct 1986)			
	14:42249	*See* Juel-Conf–69			
CONF-8611137–		(International congress on applications of lasers and electro optics; 1 Nov 1986)			
4	14:42585	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015318/JAW	MF-406
5	14:43261	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015319/JAW	MF-406
CONF-870172–		(11. annual conference on composites and advanced ceramic materials; 18-23 Jan 1987)			
	14:42498	*See* AECL–9437			
CONF-870295–		(Technical seminar on chemical spills; Toronto (Canada); 9-12 Feb 1987)			
	14:43426	*See* CPS–8702			
CONF-8703323–		(International conference of nuclear equipment - welding and Q.A.; Mar 1987)			
	14:41994	*See* AECL–9421			
CONF-8705381–		(Clean air conference '87; Lillehammer (Norway); 4-6 May 1987)			
	14:42225	*See* NEI-NO–89			
CONF-8706400–		(5th international Williston Basin symposium; Grand Forks, U (USA); 14-17 Jun 1987)			
	14:41510	*See* SGS–9			
CONF-8707208–		(U.S. Particle Accelerator School: physics of particle accelerators; Batavia, IL (USA); 20 Jul - 14 aug 1987)			
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CONF-870812–		(9. biennial international conference on structural mechanics in reactor technology (SMIRT-9); 17-21 Aug 1987)			
	14:42449	*See* GKSS–87/E/64			
CONF-8708173–		(5. international symposium on the chemistry of selenium and tellurium; 24-28 Aug 1987)			
	14:43571				
CONF-8709294–		(19. Ecole de Physique des Particules (Gif-sur-Yvette summer school of Particle Physics); Marseille-Luminy (France); 7-11 Sep 1987)			
	14:43861	*See* IN2P3–89-01			
CONF-8709455–		(Swedish Flame Days conference; Studvik (Sweden); 8-9 Sep 1987)			
1	14:41490	*See* STEV-FBT–89-13			
CONF-8709456–		(Project leader conferece at STEV; Stockholm (Sweden); 24 Sep 1987)			
1	14:43034	*See* STEV-FBT–89-14			
CONF-8709458–		(RTAC annual conference; Saskatoon (Canada); Sep 1987)			
	14:42406	*See* OTC–RT-87-01			
CONF-8710480–		(National conference on energy efficient cooling; San Jose, CA (USA); 21-22 Oct 1987)			
	14:42385	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013864/JAW	MF-350
CONF-8710488–		(Workshop on neutron scattering research with intense spallation neutron source; 6-7 Oct 1987)			
	14:44011	*See* KEK–88-9			
CONF-8711314–		(Seminar on the application of nuclear techniques in industry; 17 Nov 1987)			
	14:41507	*See* INIS-mf–11472			
	14:41788	*See* INIS-mf–11476			
	14:41789	*See* INIS-mf–11477			
	14:43169	*See* INIS-mf–11473			
	14:43170	*See* INIS-mf–11475			
	14:43265	*See* INIS-mf–11474			
	14:43604	*See* INIS-mf–11478			
CONF-8712127–		(67. PTB-seminar on state and development of gas calorimetry and charging for heating gas; Braunschweig (Germany, F.R.); 10-11 Dec 1987)			
	14:42218	*See* PTB-W–37			
CONF-8712144–		(Advisory group on nuclear data for the calculation of thermal reactor reactivity coefficients; 7-10 Dec 1987)			
	14:41955	*See* IAEA-TECDOC–491			

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CONF-8802102–		(Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT); Upton, NY (USA); 1-2 Feb 1988)			
	14:43560	*See* BNL–43121-CP			
CONF-8802131–		(International meeting on robotics and remote maintenance concepts for fusion machines; 22-24 Feb 1988)			
	14:44263	*See* IAEA-TECDOC–495			
CONF-8802148–		(2. Hohenheim seminar: decontamination of sewage sludge - reports from practice; 23-24 Feb 1988)			
	14:42386	NTIS (US Sales Only), PC A15/MF A01; NTIS (US Sales Only), PC A15/MF A01		DE89910962/JAW	MF-000
CONF-880301–		(Annual meeting of the American Association of Petroleum Geologists; 20-23 Mar 1988)			
	14:41543				
CONF-8803227–		(Symposium on thermoluminescence dosimetry; Bilthoven (Netherlands); 30 Mar 1988)			
	14:43222	*See* NCS-R–3			
CONF-8803228–		(7. status report of the Reprocessing and Waste Treatment Project of Kernforschungszentrum Karlsruhe GmbH; Karlsruhe (Germany, F.R.); 15-16 Mar 1988)			
	14:41669	*See* KFK–4476			
CONF-8804112–		(Interfacial structure, properties and designs in solids; 5-9 Apr 1988)			
	14:42426	Members, $37.; nonmembers, $44			
CONF-8804114–		(Better ceramics through chemistry III; 5-9 Apr 1988)			
	14:42521	Members, $43.; nonmembers, $51			
CONF-8804290–		(International conference on advanced technology and particle physics; 16. international meeting on fundamental physics on CP non conservation and B physics; Como (Italy); 12-17 Jun 1988; 25-29 apr 1988)			
	14:43049	*See* LAPP-EXP–88-13			
CONF-8804293–		(International symposium on dispersion and effects of photooxidants in the Alpine regions; Garmisch-Partenkirchen (Germany, F.R.); 11-15 Apr 1988)			
	14:43328	*See* GSF–17/88			
CONF-880505–		(3. topical meeting on tritium technology in fission, fusion and isotopic applications; 1-6 May 1988)			
	14:42882				
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CONF-8805174–		(IAEA consultants' meeting on the physics of neutron emission in fission; 24-27 May 1988)			
	14:43807	*See* KEK–88-10			
CONF-8805285–		(8. international conference on plasma surface interactions in controlled fusion devices (PSI-8); 2-6 May 1988)			
	14:44228				
	14:44229				
CONF-8805315–		(7. seminar on precise measurements in nuclear spectroscopy; Vilnyus (USSR); 26-27 May 1988)			
	14:43878	*See* INIS-SU–100			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8806101–		(International symposium on heavy ion inertial fusion; Darmstadt (Germany, F.R.); 28-30 Jun 1988)			
	14:43080				
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	14:43082				
	14:43122				
	14:44295				
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	14:44304				
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	14:44309				
CONF-8806235–		(International conference on advanced technology and particle physics; 16. international meeting on fundamental physics on CP non conservation and B physics; Como (Italy); 12-17 Jun 1988; 25-29 apr 1988)			
	14:43049	*See* LAPP-EXP–88-13			
	14:43245				
	14:43246				
	14:43247				
	14:43248				
	14:43249				
	14:43250				
CONF-880765–		(4. international symposium on applications of laser anemometry to fluid mechanics; 11-14 Jul 1988)			
2	14:41477	NTIS, PC A02/MF A01 - OSTI		DE89016322/JAW	MF-114;MN-115;MN-104
CONF-880766–		(5. international conference on clustering aspects in nuclear and subnuclear systems; Kyoto (Japan); 25-29 Jul 1988)			
	14:43888	*See* GANIL-P–88-12			
CONF-880807–		(4. UNITAR/UNDP international conference on heavy crude and tar sands; Edmonton (Canada); 7-12 Aug 1988)			
	14:41618	*See* AOSTRA–8808			
CONF-8808104–		(DOE Office of Fossil Energy workshop on bioprocessing of coals; 15-18 Aug 1988)			
3	14:43576	*See* EGG-M–88344			
CONF-8808259–		(CERN school of computing; Oxford (UK); 15-26 Aug 1988)			
	14:44353	*See* CERN–89-06			
CONF-8808262–		(Annual meeting of the Ecological Society of American on satellite remote sensing in ecology; 12-19 Aug 1988)			
1	14:41839	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016160/JAW	MF-402
CONF-880862–		(BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988)			
	14:43812				
CONF-8809163–		(Agreement on the program on joint planning in the area of fusion materials topical meeting; 2-6 Sep 1988)			
2	14:42509	*See* LA-UR–89-2346			
CONF-8809201–		(American Institute of Mechanical Engineers meeting; 25-29 Sep 1988)			
5	14:42444	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016159/JAW	MF-404
CONF-8809345–		(AAPG Eastern section meeting; 13-15 Sep 1988)			
	14:41593				
CONF-8809378–		(10. OECD meeting of work group GTP4; Paris (France); 29-30 Sep 1988)			
	14:42084	*See* CEA-DAS–541e			
CONF-881011–		(Joint meeting of the European Nuclear Society and the American Nuclear Society; Washington, DC (USA); 30 Oct - 4 nov 1988)			
	14:41752				
	14:41753				

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
	14:41754				
	14:41755				
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	14:41963				
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	14:44311				
	14:44312				
	14:44313				
CONF-8810134–		(Symposium on radon and radon reduction technology; Denver, CO (USA); 17-21 Oct 1988)			
6	14:42311	*See* LBL–27363			
CONF-881015–		(12. international conference on plasma physics and controlled nuclear fusion research; Nice (France); 12-19 Oct 1988)			
	14:44250	*See* CEA-CONF–9689			
CONF-8810182–		(International collaboration on advanced neutron sources (ICANS); 3-7 Oct 1988)			
31	14:41793	*See* LA-UR–89-2591			
CONF-8810401–		(High power laser optical components topical meeting; 24-25 Oct 1988)			
1	14:44136	*See* UCRL–99314			
CONF-8810407–		(Nuclear structure workshop; Frascati (Italy); 27-28 Oct 1988)			
	14:43819	*See* INFN-LNF–89-013(PT)			
CONF-8810410–		(International workshop on risk communication; Juelich (Germany, F.R.); 17-20 Oct 1988)			
	14:43667	*See* Juel-Conf–70			

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CONF-881049–		(14. linear accelerator conference (LINAC-14); 3-7 Oct 1988)			
74	14:43098	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016082/JAW	MF-414
75	14:43068	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016083/JAW	MF-414
CONF-881119–		(Symposium on flow induced vibration and noise; Chicago, IL (USA); 28 Nov - 2 dec 1988)			
	14:42954	*See* CEA-CONF–9744			
CONF-8811195–		(MRS symposium on characterization of the structure and chemistry of defects in materials; Boston, MA (USA); 28 Nov - 3 dec 1988)			
	14:42445	NTIS, PC A25/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014796/JAW	MF-404
CONF-881123–		(3. international symposium on liquid-solid flows (WAM); Chicago, IL, (USA); November 28, 1988)			
1	14:41802	*See* DOE/PC/79935–3			
CONF-8811244–		(The role of electricity in the energy systems of the future; Stockholm (Sweden); 23 Nov 1988)			
	14:42280	*See* IVA–364			
CONF-8811249–		(21. annual meeting of Fachverband fuer Strahlenschutz e.V: Non-ionizing radiation (NIR); Koeln (Germany, F.R.); 7-9 Nov 1988)			
	14:43602	*See* FS–88-47-T			
CONF-881151–		(10. international conference on the application of accelerators in research and industry; Denton, TX (USA); 7-9 Nov 1988)			
Pt.1	14:43045	Elsevier Science Publishers, P.O. box 882, Madison Square, New York, NY 10159			ND-414
Pt.2	14:43046	Elsevier Science Publishers, P.O. Box 882, Madison Square, New York, NY 10159			ND-414
CONF-881155–		(Fall meeting of the Materials Research Society; Boston, MA (USA); 28 Nov - 3 dec 1988)			
75	14:42917	*See* SAND–88-3060C			
CONF-881206–		(4. Israel materials engineering conference; Beer-Sheva (Israel); 7-8 Dec 1988)			
	14:42500	*See* CEA-CONF–9779			
CONF-8812101–		(Specialists' workshop on phase transition studies on hydrogen-bonded crystals by neutron and X-ray diffractometries; Kumatori (Japan); 12-13 Dec 1988)			
	14:42691	*See* KURRI-TR–311			
CONF-881257–		(State Committee for Utilization of Atomic Energy meeting; Moscow (USSR); 4-10 Dec 1988)			
	14:42624	*See* INIS-SU–104/A			
CONF-8901115–		(Topical conference on electronuclear physics with internal targets; Stanford, CA (USA); 9-12 Jan 1989)			
4	14:43839	*See* LBL–27234			
CONF-8901145–		(3. international conference on path integrals from meV to MeV; Bangkok (Thailand); 9-13 Jan 1989)			
	14:44172	*See* BiBoS–354/89			
CONF-890142–		(Symposium on lasers and optics; 15-20 Jan 1989)			
5	14:43269	*See* LBL–26882			
CONF-890145–		(SPIE conference on optics, electro-optics and laser applications in science and engineering: OE/LASE '89; 15-20 Jan 1989)			
26	14:42943	*See* UCRL–100420			
CONF-890189–		(Berkeley colloquium on extreme ultraviolet astronomy; 19-20 Jan 1989)			
7	14:43727	*See* LA-UR–89-2422			
CONF-890279–		(7. conference on interactive instruction delivery; Kissimmee, FL, US; February 22, 1989)			
1	14:41749	*See* WHC-SA–0508			
CONF-890299–		(AHF accelerator design workshop; 20-25 Feb 1989)			
16	14:43139	*See* LA-UR–89-2340			
CONF-8903100–		(9. U.S. compact toroid symposium; Union, WA (USA); 14-15 Mar 1989)			
4	14:44216	*See* LA-UR–89-2474			
CONF-8903110–		(7. European seminar on thermal non-equilibrium in two-phase flow; Rome (Italy); 23-24 Mar 1989)			
	14:42957	*See* INIS-mf–11484			

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CONF-8903124–		(Geothermal program review meeting; Washington, DC (USA); 15 Mar 1989)			
2	14:41887	*See* EGG-M–89077			
CONF-8903143–		(24. Recontres de Moriond: new results in hadronic interactions; Les Arcs (France); 12-18 Mar 1989)			
4	14:43805	*See* FNAL/C–89/151-E			
CONF-8903152–		(Nuclear Societies of Israel annual meeting; Beer-Sheva (Israel); 13 Mar 1989)			
	14:43872	*See* INIS-mf–11503			
CONF-890318–		(Joint symposium on stationary combustion nitrogen oxide control; 6-9 Mar 1989)			
Vol.2	14:41923	*See* EPRI-GS–6423-Vol.2			
CONF-890335–		(13. particle accelerator conference; Chicago, IL (USA); 20-23 Mar 1989)			
237	14:43069	*See* FNAL/C–89/137			
238	14:43074	*See* LBL–25988			
239	14:43079	*See* UCRL–99782			
241-Vugraphs	14:43097	*See* BNL–42947			
242	14:43141	*See* LBL–25978			
243	14:43140	*See* LBL–25976			
244	14:43050	*See* LBL–25962			
245	14:43118	*See* LBL–26012			
246	14:43115	*See* LBL–25965			
247	14:43117	*See* LBL–25992			
248	14:43114	*See* LBL–25964			
249	14:43116	*See* LBL–25973			
CONF-890360–		(Eastern multiconference; Tampa, FL (USA); 28-31 Mar 1989)			
6	14:44360	*See* DOE/ER/25009–695			
CONF-890372–		(4. hypercube, concurrent computers and applications; Monterey, CA (USA); 6-8 Mar 1989)			
14	14:44361	*See* DOE/ER/25009–769			
15	14:44359	*See* DOE/ER/25009–681b			
CONF-890379–		(Workshop on calorimetry for the SSC; Tuscaloosa, AL (USA); 13-17 Mar 1989)			
13	14:43219	*See* LBL–27327			
CONF-890387–		(Workshop on highly charged ions: new physics and advanced techniques; 13-15 Mar 1989)			
7	14:43728	*See* LBL–27392			
CONF-890415–		(Computing in high energy physics; 10-14 Apr 1989)			
9	14:44370	*See* FNAL/C–89/142			
10	14:44362	*See* FNAL/C–89/120			
CONF-8904156–		(CSNI-CEC specialist meeting on trends and pattern analyses of operational data from nuclear power plants; Rome (Italy); 3-7 Apr 1989)			
	14:42085	*See* CEA-DAS–582			
CONF-8904159–		(International Atomic Energy Agency fusion reactor safety meeting; Jackson, WY (USA); 4-7 Apr 1989)			
4	14:44260	*See* GA-A–19687			
CONF-8904216–		(Gamma ray observatory science workshop; 10-12 Apr 1989)			
5	14:43726	*See* LA-UR–89-2384			
CONF-8904226–		(12. international workshop on weak interactions and neutrinos; 9-14 Apr 1989)			
6	14:43840	*See* LBL–27481			
CONF-8904228–		(CERN accelerator school; Chester (UK); 6-13 Apr 1989)			
3	14:43078	*See* SLAC-PUB–5021			
CONF-890423–		(CLEO '89: conference on lasers and electro optics; Baltimore, MD (USA); 24-28 Apr 1989)			
13-Vugraphs	14:44292	*See* UCRL–100013			
CONF-8904230–		(AVS topical conference on surface conditioning of vacuum systems; Los Angeles, CA (USA); 3-7 Apr 1989)			
3	14:44261	*See* GA-A–19693			
CONF-8904242–		(International congress on optical science and engineering; Paris (France); 24-28 Apr 1989)			
2	14:42942	*See* UCRL–99646			
3	14:43279	*See* SAND–88-2911C			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8904262–		(2. National Symposium on paraseismic engineering; 18-20 Apr 1989)			
	14:43692	*See* CEA-DAS–599			
	14:43693	*See* CEA-DAS–600			
	14:43694	*See* CEA-DAS–601			
CONF-890462–		(6. Oxford conference on microscopy of semiconducting materials; Oxford (UK); 10-13 Apr 1989)			
1	14:43260	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015915/JAW	MF-404
CONF-890509–		(11. symposium on biotechnology for fuels and chemicals; 8-12 May 1989)			
3	14:41838	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016334/JAW	MF-372
CONF-8905120–		(8. American Physical Society topical conference on radio frequency power in plasmas; Irvine, CA (USA); 1-3 May 1989)			
20	14:44218	*See* LBL–27108			
21	14:44198	*See* GA-A–19676			
22	14:44217	*See* LBL–26813			
CONF-8905126–		(Workshop on cold fusion phenomena; Santa Fe, NM (USA); 23-25 May 1989)			
3	14:44189	*See* LA-UR–89-2398			
CONF-8905143–		(NATO international advanced courses on the nuclear equation of state; Peniscola (Spain); 12 May - 3 jun 1989)			
8	14:43818	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015369/JAW	MF-414
9	14:44190	*See* UCRL–101583			
CONF-8905144–		(Tau-Charm workshop; Stanford, CA (USA); 23-27 May 1989)			
3	14:43842	*See* SLAC-PUB–5003			
CONF-8905159–		(Joint IAEA technical committee meeting on ECE and ECRH and 7th joint workshop on ECE and ECRH (EC-7); 8-11 May 1989)			
2	14:44197	*See* GA-A–19634			
CONF-8905193–		(Workshop on physics and experimental techniques of high energy neutrinos and VHE and UHE gamma-ray particle astrophysics; 11-13 May 1989)			
1	14:43218	*See* LA-UR–89-2404			
CONF-8905194–		(4. Pisa meeting on advanced detectors: frontier detectors from frontier physics; 21-26 May 1989)			
1	14:43242	*See* SLAC-PUB–5028			
2	14:43243	*See* SLAC-PUB–5041			
CONF-890521–		(8. international conference on thermal destruction of hazardous, radioactive, infectious and mixed wastes; 1-5 May 1989)			
12	14:41709	*See* EGG-M–89157			
CONF-890545–		(6. conference on real-time computer applications in nuclear, particle and plasma physics; Williamsburg, VA (USA); 15-18 May 1989)			
9	14:44364	*See* FNAL/C–89/131			
10	14:44365	*See* FNAL/C–89/132			
11	14:44363	*See* FNAL/C–89/130			
12	14:44369	*See* FNAL/C–89/136			
13	14:44366	*See* FNAL/C–89/133			
14	14:44367	*See* FNAL/C–89/134			
15	14:44368	*See* FNAL/C–89/135			
16	14:44371	*See* FNAL/C–89/143			
CONF-890583–		(Symposium on the occasion of the 40th anniversary of the nuclear shell model; Argonne, IL (USA); 25-27 May 1989)			
2	14:43906	*See* BNL–42948			
CONF-890594–		(3. advanced inertial confinement fusion accelerator beam dynamics workshop: beam-beam effects in circular colliders; 20 May - 3 jun 1989)			
3	14:43075	*See* LBL–27351			
4	14:43067	*See* BNL–42954			
CONF-890605–		(11. international processing in medical imaging international conference; Berkeley, CA (USA); 19-23 Jun 1989)			
1	14:44374	*See* LA-UR–89-2255			

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CONF-8906148–		(Fusion Power Associates annual meeting; Washington, DC (USA); 1-2 Jun 1989)			
3	14:44255	*See* EGG-M–89201			
CONF-8906155–		(Radiation effects in insulators-5: crystalline oxides and ceramics session; 19-23 Jun 1989)			
4	14:42503	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016234/JAW	MF-404
CONF-890617–		(2. Karlsruhe international conference on analytical chemistry in nuclear technology; Karlsruhe (Germany, F.R.); 5-9 Jun 1989)			
	14:42636	*See* INIS-mf–11989			
CONF-8906178–		(Summer study on high energy physics in the 1990's; Snowmass, CO (USA); 27 Jun - 15 jul 1989)			
1	14:43804	*See* ANL-HEP-CP–89-19			
CONF-890618–		(NICOLS '89: 9th international conference on laser spectroscopy; Bretton Woods, NH (USA); 18-23 Jun 1989)			
4	14:42693	*See* LA-UR–89-2540			
CONF-8906186–		(Materials Research Society materials analysis workshop; 14-17 Jun 1989)			
2	14:44164	*See* LA-UR–89-2587			
3	14:42609	*See* SAND–89-1208C			
CONF-8906187–		(Surface modified oxide conference; 29 Jun 1989)			
1	14:42742	*See* SAND–89-0287C			
CONF-8906190–		(EPA soil vapor extraction technology workshop; 28 Jun 1989)			
1	14:43425	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015870/JAW	MF-000
CONF-8906192–		(3. international symposium on protection against chemical warfare agents; Umea (Sweden); 11-16 Jun 1989)			
1	14:42612	*See* UCRL–101244			
CONF-8906194–		(International meeting on physics at KAON; 7-9 Jun 1989)			
1	14:43898	*See* BNL–42974			
CONF-890631–		(International symposium on packaging and transporting of radioactive materials; Washington, DC (USA); 11-16 Jun 1989)			
60	14:42919	*See* UCRL–99648			
61	14:42918	*See* SAND–89-0963C			
62	14:42907	*See* EGG-M–88416			
63	14:42448	*See* EGG-M–88375			
66	14:42906	*See* EGG-M–88359			
CONF-890665–		(7. Institute of Electrical and Electronics Engineers pulsed power conference; Monterey, CA (USA); 12-14 Jun 1989)			
36-Rev.1	14:44293	*See* UCRL–100358-Rev.1			
41	14:43018	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015859/JAW	MF-406
43	14:43119	*See* UCRL–100316			
CONF-890674–		(7. international conference on Fourier transform spectroscopy; Fairfax, VA (USA); 19-23 Jun 1989)			
4	14:43021	*See* SAND–88-3403C			
CONF-890697–		(NATO Advanced Study Institute on non-equilibrium processes in partially ionized gases; Acquafredda di Maratea (Italy); 4-17 Jun 1989)			
2	14:43761	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015307/JAW	MF-411
CONF-890701–		(International cryogenic materials conference; 24-28 Jul 1989)			
2	14:42501	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016079/JAW	MF-404
CONF-890703–		(International conference on ion sources; Berkeley, CA (USA); 9-15 Jul 1989)			
14	14:43099	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015866/JAW	MF-414
15	14:43775	*See* LBL–26795			
CONF-890708–		(16. international conference on the physics of electronic and atomic collisions; New York, NY (USA); 26 Jul - 1 aug 1989)			
1	14:43762	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015908/JAW	MF-411
2	14:43774	*See* LA-UR–89-2473			
CONF-8907113–		(5. international conference on environmental mutagens; 10-15 Jul 1989)			
6	14:43625	*See* UCRL–101498			

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5-Vugraphs	14:43556	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015367/JAW	MF-408
CONF-8907116–		(22. annual international Metallographic Society meeting; 23 Jul 1989)			
2	14:42464	*See* MLM–3601-OP			
3	14:43270	*See* MLM–3602-OP			
CONF-8907118–		(25. American Society of Mechanical Engineers joint propulsion conference; Monterey, CA (USA); 10-13 Jul 1989)			
1	14:42338	*See* PNL-SA–17177			
CONF-890718–		(International conference on materials and mechanisms of superconductivity - high-temperature superconductors; Stanford, CA (USA); 23-28 Jul 1989)			
12	14:42511	*See* LBL–27404			
13	14:42510	*See* LBL–27403			
14	14:42502	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015872/JAW	MF-404
15	14:42512	*See* LBL–27405			
16	14:44165	*See* LBL–27402			
17	14:44163	*See* LA-UR–89-2469			
18	14:42518	*See* UCRL–101356			
19	14:42519	*See* UCRL–101357			
20	14:44166	*See* UCRL–100539			
21	14:44167	*See* UCRL–101311			
22	14:44151	*See* BNL–43065			
23	14:44152	*See* BNL–43072			
24	14:42517	*See* SAND–89-1876C			
CONF-890723–		(26. annual conference on nuclear and space radiation effects; Marco Island, FL (USA); 24-28 Jul 1989)			
12	14:43216	*See* LA-UR–89-2375			
CONF-890736–		(30. annual meeting of the Institute of Nuclear Materials Management; Orlando, FL (USA); 9-12 Jul 1989)			
51	14:41770	*See* DOE/SSDP–0078			
54	14:41775	*See* LA-UR–89-2534			
CONF-890739–		(12. international colloquium on the dynamics of explosions and reactive systems; Ann Arbor, MI (USA); 23-28 Jul 1989)			
2	14:42131	*See* SAND–89-1692C			
3	14:43244	*See* UCRL–100106			
CONF-890798–		(AIRAPT and EHPRG international high pressure science and technology conference; Paderborn (Germany, F.R.); 17-21 Jul 1989)			
4	14:43798	*See* LA-UR–89-2485			
6	14:44132	*See* LA-UR–89-2419			
7	14:43773	*See* LA-UR–89-2335			
CONF-890810–		(Seminar on small and medium sized reactors, design, safety and marketing potential; San Diego, CA (USA); 21-23 Aug 1989)			
3	14:42062	*See* GA-A–19702			
CONF-8908100–		(SPIE symposium on nonlinear optical properties of organic materials II; San Diego, CA (USA); 10-11 Aug 1989)			
1	14:42610	*See* SAND–89-1696C			
CONF-8908103–		(4. joint Swedish/Soviet international workshop on information theory; Gutland (Sweden); 27 Aug - 1 sep 1989)			
1	14:44403	*See* SAND–89-1869C			
CONF-8908104–		(7. international conference on mathematical and computer modelling; Chicago, IL (USA); 2-5 Aug 1989)			
1	14:41702	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015869/JAW	MF-721
2	14:43553	*See* LA-UR–89-2451			
CONF-890811–		(9. international symposium on detonation; 28 Aug - 1 sep 1989)			
26	14:42607	*See* SAND–88-2448C			
CONF-890812–		(American Physical Society topical conference on shock compression of condensed matter; 14-17 Aug 1989)			
3	14:43304	*See* LA-UR–89-2567			
4	14:42462	*See* LA-UR–89-2572			

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5	14:42692	*See* LA-UR–89-2423			
6	14:42515	*See* SAND–89-0918C			
7	14:42608	*See* SAND–89-0763C			
CONF-890814–		(American Institute of Chemical Engineer's summer national meeting; Philadelphia, PA (USA); 20-23 Aug 1989)			
1	14:43303	NTIS, PC A03/MF A01 - OSTI		DE89016080/JAW	MF-000
CONF-890815–		(24. intersociety energy conversion engineering conference; Washington, DC (USA); 7-12 Aug 1989)			
20	14:43120	*See* UCRL–100416			
21	14:41886	*See* EGG-M–89001			
CONF-890820–		(4. international symposium on environmental degradation of materials in nuclear power systems: water reactors; Jekyll Island, GA (USA); 6-10 Aug 1989)			
2	14:42443	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015867/JAW	MF-404
CONF-890836–		(33. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA (USA); 6-11 Aug 1989)			
3	14:43217	*See* LA-UR–89-2382			
4	14:43268	*See* LA-UR–89-2547			
6	14:42920	*See* UCRL–100365			
CONF-890845–		(4. international energy conservation program evaluation conference; Chicago, IL (USA); 21-25 Aug 1989)			
3	14:42217	*See* LBL–27275			
CONF-890854–		(11. annual DOE low level waste management conference; 22-24 Aug 1989)			
7	14:41701	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015362/JAW	MF-721
CONF-890861–		(13. biennial international conference on amorphous and liquid semiconductors (ICALS-13) and the first international conference on amorphous semiconductor technology (ICAST-1); Asheville, NC (USA); 21-26 Aug 1989)			
1	14:43220	*See* LBL–27457			
CONF-890876–		(Waterpower '89: international conference on hydropower; 23-25 Aug 1989)			
2	14:41832	*See* EGG-M–89190			
CONF-890885–		(Flash radiography topical symposium; Portland, OR (USA); 15-18 Aug 1989)			
7	14:43306	*See* UCRL–101025			
CPS–					
4HA1	14:43519	Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
8702	14:43426	Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
CRIEPI-EW–					
87001	14:41483				ND-000
87002	14:42504				ND-000
87003	14:41484	Central Research Inst. of Electric Power Industry, Tokyo (Japan)			ND-000
87005	14:41421				ND-000
CRIEPI-T–					
87106	14:41470				ND-000
CRIEPI-U–					
13	14:41454	Central Research Inst. of Electric Power Industry, Abiko, Chiba (Japan)			ND-000
87098	14:41446				ND-000
88036	14:41498				ND-000
CRREL–					
88-20	14:42380	*See* AD-A–205955/8/XAB			

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CRREL-SR–					
89-3	14:42221	*See* AD-A–205560/6/XAB			
CS–					
8813	14:44375	*See* PB–89-183669/XAB			
CSC–					
143-G-299	14:43433	Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
CSIR-ME–					
2042	14:42312	*See* PB–89-170476/XAB			
519	14:42421	*See* PB–89-164628/XAB			
535	14:43007	*See* PB–89-167357/XAB			
CSIR-R-ELEK–					
403	14:41952	*See* PB–89-177299/XAB			
407	14:41475	*See* PB–89-177315/XAB			
413	14:41476	*See* PB–89-177364/XAB			
417	14:41953	*See* PB–89-177380/XAB			
CSIR-RR–					
599	14:41794	*See* PB–89-168090/XAB			
CTR–					
3-9-86-451-1F	14:42596	*See* PB–89-180384/XAB			
CU-CPE–					
1981	14:41441	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1			ND-000
CU/KC–					
88-3	14:41634	Alberta Legislative Library, 216 Legislature Bldg., Edmonton, AB, CAN T5K 2B6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-5	14:41635	Alberta Legislative Library, 216 Legislature Bldg., Edmonton, AB, CAN T5K 2B6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
DFVLR-FB–					
85-36	14:41866	NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01		DE89911461/JAW	MF-000
DFVLR-Mitt.–					
88-06	14:41893	NTIS (US Sales Only), PC A10/MF A01; NTIS (US Sales Only), PC A10/MF A01		DE89911041/JAW	MF-000
89-04	14:43324	NTIS (US Sales Only), PC A07/MF A01; NTIS (US Sales Only), PC A06/MF A01		DE89796108/JAW	MF-000
DGMK–					
174-4	14:43630	Copy held by UB/TIB Hannover.			MF-000
359	14:43030	Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.)			ND-000
DNV/C–					
48SZ23304-6-5006	14:43038	Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
DOE-RW–					
88.079	14:42582	*See* AERE-R–13019			
88.101	14:42087	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635258/JAW	MF-000
88.127	14:41757	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635265/JAW	MF-000
DOE/AL/10752–					
41	14:43548	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015377/JAW	MF-702
DOE/AL/21557–					
T13	14:41875	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015784/JAW	MF-235
DOE/BC/14204–					
T1	14:41532	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016463/JAW	MF-122

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DOE/BC/14403–					
1	14:41506	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015151/JAW	MF-122;MN-132
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0245-2	14:42258	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016623/JAW	MF-350
DOE/CE/26577–					
T2	14:42387	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016117/JAW	MF-350
DOE/CE/27471–					
T1	14:42270	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016090/JAW	MF-350
T2	14:42271	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016091/JAW	MF-350
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7	14:42344	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015821/JAW	MF-246
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1	14:42400	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015376/JAW	MF-336
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T1	14:42345	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015317/JAW	MF-373
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0093	14:42086	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015340/JAW	MF-630
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0095(88)	14:42272	NTIS, PC A14/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89016283/JAW	MF-950
0109(89/05)	14:41556	NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89016375/JAW	MF-950
0130(89/05)	14:41597	NTIS, PC A08/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89016458/JAW	MF-950
0202(89/3Q)	14:42263	NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89016393/JAW	MF-950
0226(89/05)	14:42273	NTIS, PC A08/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89016281/JAW	MF-950
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DOE/ER/45130–					
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DOE/ER/45184–					
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DOE/ER/45247–					
2	14:42292	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016449/JAW	MF-401

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DOE/ER/45376–					
1	14:44044	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016337/JAW	MF-410
DOE/ER/53201–					
2	14:44191	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016371/JAW	MF-420
DOE/ER/53244–					
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DOE/ER/53266–					
26	14:44193	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016107/JAW	MF-421
27	14:44194	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016108/JAW	MF-421
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3	14:43765	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015827/JAW	MF-411
DOE/ER/60531–					
1	14:43597	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016448/JAW	MF-402
DOE/ER/60575–					
2	14:43559	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015926/JAW	MF-402
DOE/ER/60685–					
2	14:43575	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016154/JAW	MF-408
DOE/ER/69010–					
1	14:43352	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015965/JAW	MF-408
DOE/ET/12002–					
2714	14:41533	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89001000/JAW	MF-122
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8	14:43631	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015789/JAW	MF-408
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T1	14:41760	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016092/JAW	MF-511
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74	14:43434	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016429/JAW	MF-721
79	14:41761	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016331/JAW	MF-721
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2717	14:41907	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011671/JAW	MF-103
2718	14:41908	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011672/JAW	MF-103
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2710	14:41590	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000995/JAW	PC-132;STD-132
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1950-Vol.13	14:41591	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011674/JAW	PC-132;STD-132
DOE/MC/21353–					
2663	14:41485	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000939/JAW	PC-103;STP-114;STD-103;STD-114
DOE/MC/22144–					
2722	14:41422	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000937/JAW	PC-106;STD-106
DOE/MC/23023–					
2703	14:42293	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000989/JAW	PC-110;STD-110
DOE/MC/23261–					
2723	14:41423	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011687/JAW	PC-106;STD-106

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DOE/MC/23267–2715	14:42294	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011669/JAW	PC-110;STD-110
DOE/NE/37946–4	14:42004	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016447/JAW	MF-530
DOE/NE/37949–T3	14:42041	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016089/JAW	MF-506;MN-520
DOE/NE/44139–46	14:41705	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015388/JAW	MF-510
DOE/NV/10322–37	14:43675	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015380/JAW	MF-703
DOE/NV/10576–T3	14:41706	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016000/JAW	MF-814
DOE/NV/10630–4	14:41707	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016250/JAW	MF-721
T1	14:43421	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015932/JAW	MF-708
DOE/OR/21389–21	14:41810	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015927/JAW	MF-247
DOE/OR/21390–24	14:41841	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015928/JAW	MF-241
DOE/OR/21479–T1	14:41708	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016438/JAW	MF-511
DOE/OR/21548–061-Rev.0	14:41762	NTIS, PC A06/MF A01 - OSTI		DE89016206/JAW	MF-511
092-Rev.0	14:41763	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016201/JAW	MF-511
DOE/PC/50001–49	14:41424	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015876/JAW	PC-108;STD-108
DOE/PC/60797–T4	14:41425	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015877/JAW	MF-102
DOE/PC/79668–T4-Vol.1-Exec.Summ.	14:43325	NTIS, PC A13/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015742/JAW	PC-112;STD-112
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DOE/PC/79813–T2	14:41427	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016624/JAW	MF-108
DOE/PC/79933–T8	14:41428	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013220/JAW	MF-108
DOE/PC/79935–3	14:41802	NTIS, PC A03/MF A01	E 1.99:	DE88009626/JAW	MF-108
DOE/PC/80907–T11	14:41429	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016406/JAW	PC-108;STD-108
DOE/PC/88810–2	14:41430	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016625/JAW	MF-108
DOE/PC/88856–T1	14:41431	NTIS, PC A03/MF A01 - OSTI		DE89015215/JAW	MF-102
DOE/PC/88859–T4	14:41486	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016627/JAW	MF-104
DOE/PC/88866–T3	14:41455	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016377/JAW	MF-105
DOE/PC/88867–T3	14:41922	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015764/JAW	MF-105
DOE/PC/88868–T1	14:41456	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015879/JAW	MF-105
DOE/PC/88874–T4	14:41457	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015881/JAW	MF-105
DOE/PC/88877–T2	14:41410	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015880/JAW	MF-102
DOE/PC/88878–T3	14:41411	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015781/JAW	MF-113

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DOE/PC/88881–					
T3	14:41412	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016387/JAW	MF-102
DOE/PC/88882–					
T3	14:41413	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015884/JAW	MF-102
DOE/PC/88917–					
3	14:41432	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016378/JAW	MF-102
DOE/PC/88918–					
2	14:41487	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015753/JAW	MF-105
DOE/PC/88924–					
3	14:41447	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016626/JAW	MF-102
DOE/PC/88934–					
T2	14:41448	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016379/JAW	MF-102
DOE/PC/88947–					
T3	14:41478	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016628/JAW	MF-115
DOE/PC/89864–					
T1	14:41479	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016443/JAW	MF-114
DOE/PC/90510–					
T2	14:41458	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016402/JAW	MF-105
T4	14:41459	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016400/JAW	MF-105
T5	14:41460	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016399/JAW	MF-105
T6	14:41461	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016398/JAW	MF-105
DOE/PC/90518–					
T8	14:41480	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016093/JAW	MF-114
DOE/PC/90539–					
T6	14:41449	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016362/JAW	MF-113
DOE/PC/90962–					
T10	14:41481	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016390/JAW	MF-104
DOE/SF/16495–					
T2	14:44406	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016427/JAW	MF-528
DOE/SSDP–					
0078	14:41770	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015890/JAW	MF-511
DOME–					
100	14:41560	Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
DP–					
1763	14:41842	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014018/JAW	PC-702
DREA-TM–					
89/203	14:42399	*See* AD-A–206702/3/XAB			
89/207	14:41548	*See* AD-A–206792/4/XAB			
DTRC/SME–					
88/74	14:42491	*See* AD-A–206260/2/XAB			
EA-THA–					
51E5-VOL-1-APP	14:43480	*See* AD-A–206275/0/XAB			
51E5-VOL-2-APP	14:43481	*See* AD-A–206277/6/XAB			
EC–					
8310	14:41471	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1			ND-000
87-01	14:43326	Canada. Atmospheric Environment Service, Climatological Services Division, Terrasses de la Chaudie@'re, 10 Wellington St., Hull, PQ, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
ARB-169-86	14:43632	Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
EC-SS–					
156	14:43509	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635121/JAW	MF-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
EC/IWD–					
1987AP	14:41813	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1987M	14:41814	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1987O	14:41815	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1987Q	14:41816	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1987S	14:41817	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
87-128	14:43469	Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
EC/WID–					
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1987	14:41820	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1987BC	14:41821	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1987O	14:41822	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1987Q	14:41823	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1987S	14:41824	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
EC/WQB–					
87-121	14:43487	Water Quality Branch, Inland Waters Directorate, ATT: John Temple, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7;MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
EE–					
1988	14:42222	Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
EGE–					
8610	14:42347	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.			ND-000
EGG–					
10617-2020	14:41564	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015315/JAW	MF-600
10617-5019	14:43263	NTIS, PC A03/MF A01 - OSTI		DE89015305/JAW	MF-706
2548-Add.1	14:42067	*See* NUREG/CR–5225-Add.1			
41	14:43548	*See* DOE/AL/10752–41			
EGG-BNCT–					
8319	14:43561	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016211/JAW	MF-500;MN-507
EGG-EAST–					
8557	14:42088	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016363/JAW	MF-506
EGG-FSP–					
8459	14:44254	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016356/JAW	MF-504
EGG-HWP–					
8128	14:42340	*See* AD-A–205977/2/XAB			
EGG-M–					
88344	14:43576	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016212/JAW	MF-102
88359	14:42906	NTIS, PC A03/MF A01 - OSTI		DE89016194/JAW	MF-812
88375	14:42448	NTIS, PC A02/MF A01 - OSTI		DE89016366/JAW	MF-804
88416	14:42907	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016365/JAW	MF-513
89001	14:41886	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016199/JAW	MF-254
89077	14:41887	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016197/JAW	MF-251
89157	14:41709	NTIS, PC A03/MF A01 - OSTI		DE89016196/JAW	MF-510
89190	14:41832	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016353/JAW	MF-225
89201	14:44255	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016217/JAW	MF-500
EMR–					
00329	14:41549	Canada Centre for Mineral and Energy Technology, Technical Information Division, 562 Booth St., Room 20C, Ottawa, ON, CAN K1A 0G1; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
84-03	14:41504	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
EMR/ER–					
87-45(TR)	14:42715	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.			ND-000
87-60(TR)	14:42897	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.			ND-000
EMR/MR–					
88-128	14:43700	Canada Centre for Mineral and Energy Technology, Technical Information Division, 562 Booth St., Room 20C, Ottawa, ON, CAN K1A 0G1; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000

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88-03	14:43598	NTIS (US Sales Only), PC A03/MF A01		DE89761961/JAW	MF-000
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88-07	14:41857	NTIS (US Sales Only), PC A04/MF A01		DE89761843/JAW	MF-000
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88-13	14:42348	NTIS (US Sales Only), PC A03/MF A01		DE89761956/JAW	MF-000
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88-03	14:44257	NTIS (US Sales Only), PC A03/MF A01		DE89761964/JAW	MF-000
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86-22	14:42005	NTIS (US Sales Only), PC A04/MF A01		DE89761994/JAW	MF-000
88-21	14:43601	NTIS (US Sales Only), PC A05/MF A01		DE89761992/JAW	MF-000
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88-6	14:41967	NTIS (US Sales Only), PC A04/MF A01		DE89761988/JAW	MF-000
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88-16	14:42006	NTIS (US Sales Only), PC A03/MF A01		DE89761991/JAW	MF-000
88-17	14:43940	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89012193/JAW	MF-000
88-17	14:43941	NTIS (US Sales Only), PC A03/MF A01		DE89761990/JAW	MF-000
88-22	14:42349	NTIS (US Sales Only), PC A04/MF A01		DE89761942/JAW	MF-000
88-23	14:43723	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89634521/JAW	MF-000
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85-4	14:42008	NTIS (US Sales Only), PC A05/MF A01		DE89761983/JAW	MF-000
85-5	14:42009	NTIS (US Sales Only), PC A03/MF A01		DE89761982/JAW	MF-000
85-6	14:42010	NTIS (US Sales Only), PC A03/MF A01		DE89761981/JAW	MF-000
85-7	14:42011	NTIS (US Sales Only), PC A03/MF A01		DE89761980/JAW	MF-000
88-02	14:42012	NTIS (US Sales Only), PC A03/MF A01		DE89761966/JAW	MF-000
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420.620-9	14:41934	NTIS (US Sales Only), PC A03/MF A01		DE89761921/JAW	MF-000
430.153-6	14:42350	NTIS (US Sales Only), PC A03/MF A01		DE89761916/JAW	MF-000
430.153-7	14:41858	NTIS (US Sales Only), PC A02/MF A01		DE89761925/JAW	MF-000
440.100-11	14:42276	NTIS (US Sales Only), PC A03/MF A01		DE89761920/JAW	MF-000
440.190-14	14:41935	NTIS (US Sales Only), PC A03/MF A01		DE89761933/JAW	MF-000
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837-87	14:42908	NTIS (US Sales Only), PC A03/MF A01		DE89761887/JAW	MF-000
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430/9-88/006	14:43535	*See* PB–89-187421/XAB			
440/5-84/007	14:43522	*See* PB–89-169825/XAB			
450/3-88/016	14:43382	*See* PB–89-184584/XAB			
450/4-83/014R	14:43367	*See* PB–89-181101/XAB			
450/4-88/022	14:43383	*See* PB–89-184709/XAB			
520/1-86/015	14:43417	*See* PB–89-172308/XAB			
530/SW-89/019	14:42235	*See* PB–89-187637/XAB			

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530/SW-89/033A	14:42365	*See* PB–89-187645/XAB			
530/SW-89/033B	14:42366	*See* PB–89-187652/XAB			
530/SW-89/040	14:42391	*See* PB–89-187629/XAB			
540/2-89/052	14:43464	*See* PB–89-190821/XAB			
540/G-89/004	14:42364	*See* PB–89-184626/XAB			
560/2-89/001	14:42232	*See* PB–89-182687/XAB			
600/4-89/010	14:43541	*See* PB–89-190581/XAB			
600/8-89/045A	14:43641	*See* PB–89-181366/XAB			
600/8-89/049A	14:43371	*See* PB–89-181374/XAB			
600/D-89/001	14:43362	*See* PB–89-173215/XAB			
600/D-89/013	14:42362	*See* PB–89-181234/XAB			
600/D-89/073	14:42363	*See* PB–89-181283/XAB			
600/D-89/074	14:43368	*See* PB–89-181275/XAB			
600/D-89/075	14:43369	*See* PB–89-181291/XAB			
600/J-88/217	14:43370	*See* PB–89-181341/XAB			
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02-88/064	14:43537	*See* PB–89-188783/XAB			
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02-88/068	14:42392	*See* PB–89-189500/XAB			
02-88/069	14:43540	*See* PB–89-189518/XAB			
03-88/053	14:43538	*See* PB–89-189468/XAB			
05-87/049	14:43533	*See* PB–89-184071/XAB			
05-88/070	14:43463	*See* PB–89-189526/XAB			
05-88/076	14:42368	*See* PB–89-189559/XAB			
06-88/023	14:43462	*See* PB–89-188817/XAB			
07-88/016	14:43460	*See* PB–89-182414/XAB			
07-88/019	14:43536	*See* PB–89-188726/XAB			
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08-88/021	14:42367	*See* PB–89-188742/XAB			
09-88/023	14:43503	*See* PB–89-196679/XAB			
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EPS–					
13	14:41565	Environmental Protection Service, Environment Canada, 351 St. Joseph Blvd., Terrasses de la Chaudie@'re, Ottawa, ON, CAN K1A 0E7; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
2/MM/1	14:41758	NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS		DE89635266/JAW	MF-000

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2/PN/1	14:41585	Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
2/PN/1-F	14:41586	Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
3/PG/1	14:43510	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89635122/JAW	MF-000
ERIM–					
209700-1-T	14:44347	*See* AD-A–206587/8/XAB			
ETDE-mf–					
9795478	14:41882	NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01		DE89795478/JAW	MF-000
9795482	14:42420	NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01		DE89795482/JAW	MF-000
9795588	14:42305	NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01		DE89795588/JAW	MF-000
9795589	14:41895	NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01		DE89795589/JAW	MF-000
9795590	14:41896	NTIS (US Sales Only), PC A11/MF A01; NTIS (US Sales Only), PC A11/MF A01		DE89795590/JAW	MF-000
9795591	14:41897	NTIS (US Sales Only), PC A07/MF A01; NTIS (US Sales Only), PC A07/MF A01		DE89795591/JAW	MF-000
9795594	14:41911	NTIS (US Sales Only), PC A14/MF A01; NTIS (US Sales Only), PC A14/MF A01		DE89795594/JAW	MF-000
9795595	14:41912	NTIS (US Sales Only), PC A18/MF A01; NTIS (US Sales Only), PC A18/MF A01		DE89795595/JAW	MF-000
9795596	14:41925	NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01		DE89795596/JAW	MF-000
9795633	14:42407	NTIS (US Sales Only), PC A09/MF A01; NTIS (US Sales Only), PC A09/MF A01		DE89795633/JAW	MF-000
9795634	14:41499	NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A04/MF A01		DE89795634/JAW	MF-000
9795695	14:41844	NTIS (US Sales Only), PC A05/MF A01; NTIS (US Sales Only), PC A05/MF A01		DE89795695/JAW	MF-000
9910823	14:42388	NTIS (US Sales Only), PC A05/MF A01; NTIS (US Sales Only), PC A05/MF A01		DE89910823/JAW	MF-000
9910825	14:42352	NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03		DE89910825/JAW	MF-000
9910841	14:42306	NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01		DE89910841/JAW	MF-000
9910845	14:42260	NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01		DE89910845/JAW	MF-000
9910993	14:43031	NTIS (US Sales Only), PC A05/MF A01; NTIS (US Sales Only), PC A05/MF A01		DE89910993/JAW	MF-000
9911005	14:42307	NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01		DE89911005/JAW	MF-000
9911010	14:42588	NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01		DE89911010/JAW	MF-000
9911011	14:42261	NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01		DE89911011/JAW	MF-000
9911035	14:41898	NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01		DE89911035/JAW	MF-000
9911036	14:43489	NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01		DE89911036/JAW	MF-000
9911044	14:41892	NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01		DE89911044/JAW	MF-000
9911049	14:41845	NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01		DE89911049/JAW	MF-000
9911074	14:41899	NTIS (US Sales Only), PC A09/MF A01; NTIS (US Sales Only), PC A09/MF A01		DE89911074/JAW	MF-000
9911076	14:41900	NTIS (US Sales Only), PC A07/MF A01; NTIS (US Sales Only), PC A10/MF A01		DE89911076/JAW	MF-000
9911077	14:41901	NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A09/MF A01		DE89911077/JAW	MF-000
9911082	14:41846	NTIS (US Sales Only), PC A07/MF A01; NTIS (US Sales Only), PC A07/MF A01		DE89911082/JAW	MF-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
9911097	14:42401	NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01		DE89911097/JAW	MF-000
9911274	14:41902	NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01		DE89911274/JAW	MF-000
ETDE/CA-MS–					
82-17E	14:42351	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.			ND-000
EUR–					
11412-FR	14:41442	Commission of the European Communities, Luxembourg			ND-000
11900-EN	14:41414	Commission of the European Communities, Luxembourg			ND-000
12063-FR	14:41482	Commission of the European Communities, Luxembourg			ND-000
12078-EN	14:41434	Hoogovens Groep BV, Ijmuiden (Netherlands); Commission of the European Communities, Luxembourg			ND-000
12079-EN	14:41443	Tar Industries Services, Chesterfield (United Kingdom); Commission of the European Communities, Luxembourg			ND-000
12082-EN	14:41435	British Coal Corp., Stoke Orchard. Coal Research Establishment; Commission of the European Communities, Luxembourg			ND-000
EXRC–					
634U577	14:42589	Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
FEARO–					
802	14:43634	Federal Environmental Assessment Review Office, Fontaine Bldg., 13th floor, Ottawa, ON, CAN K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
FEI–					
1890	14:44006	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632244/JAW	MF-000
1896	14:42014	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635555/JAW	MF-000
1897	14:42043	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635468/JAW	MF-000
1901	14:42044	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635469/JAW	MF-000
1907	14:42047	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635477/JAW	MF-000
1914	14:42048	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635478/JAW	MF-000
1918	14:42051	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635485/JAW	MF-000
1956	14:42956	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635418/JAW	MF-000
FJSRL-TR–					
88-0003	14:42196	*See* AD-A–205468/2/XAB			
89-0004	14:42199	*See* AD-A–207119/9/XAB			
FNAL-TM–					
1612	14:43070	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015587/JAW	PC-414
FNAL/C–					
89/120	14:44362	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016285/JAW	MF-414;MN-405
89/130	14:44363	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016333/JAW	MF-405
89/131	14:44364	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015238/JAW	MF-405;MN-414
89/132	14:44365	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015237/JAW	MF-405;MN-414
89/133	14:44366	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016332/JAW	MF-405
89/134	14:44367	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016330/JAW	MF-405
89/135	14:44368	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016329/JAW	MF-405
89/136	14:44369	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016328/JAW	MF-405
89/137	14:43069	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015242/JAW	MF-414
89/142	14:44370	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016327/JAW	MF-414;MN-405

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
89/143	14:44371	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016324/JAW	MF-405;MN-410
89/151-E	14:43805	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016388/JAW	MF-414
FRCEA-TH–					
151	14:43887	NTIS (US Sales Only), PC A06/MF A01		DE89908089/JAW	MF-000
201	14:42015	NTIS (US Sales Only), PC A08/MF A01		DE89908105/JAW	MF-000
FRCR–					
338	14:44193	*See* DOE/ER/53266–26			
339	14:44194	*See* DOE/ER/53266–27			
FRNC-TH–					
3473	14:42353	NTIS (US Sales Only), PC A14/MF A01		DE89908208/JAW	MF-000
FS–					
88-47-T	14:43602	NTIS (US Sales Only), PC A11/MF A01		DE89795711/JAW	MF-000
FSRB/INT–					
60	14:41812	*See* PB–89-187157/XAB			
FSRP-PNW–					
401	14:41850	*See* PB–89-178958/XAB			
FSRP/INT–					
402	14:41562	*See* PB–89-182919/XAB			
GA-A–					
19536	14:44259	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013999/JAW	PC-420
19634	14:44197	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016665/JAW	MF-421
19676	14:44198	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015217/JAW	MF-420
19687	14:44260	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015966/JAW	MF-425
19693	14:44261	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015216/JAW	MF-420
19702	14:42062	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015218/JAW	MF-522
GANIL-P–					
88-12	14:43888	NTIS (US Sales Only), PC A03/MF A01		DE89781587/JAW	MF-000
89-02	14:43916	NTIS (US Sales Only), PC A02/MF A01		DE89908094/JAW	MF-000
GAO/RCED–					
88-138	14:42246	US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
GEPP-SP–					
1122	14:43435	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016326/JAW	MF-702
GKSS–					
87/E/64	14:42449	Offprint from Wittmann, F.H. (ed.): Structural mechanics in reactor technology. Vol. F. LWR pressure components. Balkema, Rotterdam (Netherlands), 1987, p. 353-358.			MF-000
88/E/69	14:42450	Special print from Fatigue Fract. Eng. Mater. Struct. (1988) v. 11(6) p. 409-420.			MF-000
88/E/70	14:43490	Special print from Z. Wasser Abwasser Forsch. (1988) v. 21 p. 236-240.			MF-000
89/E/3	14:42451	NTIS (US Sales Only), PC A03/MF A01		DE89911458/JAW	MF-000
89/E/7	14:43327	NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A03/MF A01		DE89911495/JAW	MF-000
GKYA–					
7224DD67	14:43353	Canada Mortgage and Housing Corporation, Annex Bldg., 628 Montreal Rd., Ottawa, ON, CAN K1A 0P7; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
GQ/DGE–					
1975	14:42287	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
GRI–					
89/0081	14:41596	*See* PB–89-185870/XAB			
GRS–					
71	14:42090	Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)			ND-000
GSF–					
17/88	14:43328	NTIS (US Sales Only), PC A99/MF A01; NTIS (US Sales Only), PC A99/MF A01		DE89795432/JAW	MF-000
3/89	14:44022	NTIS (US Sales Only), PC A04/MF A01		DE89911154/JAW	MF-000
GSF-Hy–					
2/88	14:43511	NTIS (US Sales Only), PC A13/MF A01		DE89911042/JAW	MF-000

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GSI–					
89-37(prepr.)	14:42871	NTIS (US Sales Only), PC A03/MF A01		DE89795715/JAW	MF-000
89-38(prepr.)	14:42872	NTIS (US Sales Only), PC A03/MF A01		DE89795716/JAW	MF-000
89-42(prepr.)	14:41783	Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)			ND-000
89-45(prepr.)	14:43942	Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)			ND-000
GU–					
87-02	14:43542	Canadian Program Office, Canadian Climate Centre, 4905 Dufferin Street, Downsview, ON, CAN M3H 5T4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
OST85-00053	14:41534	Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
HEDL-SA–					
3564	14:42452	NTIS, PC A03/MF A01 - OSTI		DE89014954/JAW	MF-423
HETA–					
84-474-1946	14:43395	*See* PB–89-188098/XAB			
87-099-1938	14:43396	*See* PB–89-188114/XAB			
88-054-1936	14:43392	*See* PB–89-188015/XAB			
88-136-1945	14:43663	*See* PB–89-188031/XAB			
88-166-1944	14:43394	*See* PB–89-188080/XAB			
88-258-1941	14:43393	*See* PB–89-188064/XAB			
88-287-1942	14:43388	*See* PB–89-186696/XAB			
88-311-0000	14:43387	*See* PB–89-186688/XAB			
88-335-1940	14:43386	*See* PB–89-186670/XAB			
HHE–					
75-011-403	14:43376	*See* PB–89-181473/XAB			
75-150-378	14:43375	*See* PB–89-181465/XAB			
76-031-338	14:43374	*See* PB–89-181457/XAB			
77-010-412	14:43642	*See* PB–89-181986/XAB			
77-015-421	14:43377	*See* PB–89-181507/XAB			
77-022-409	14:43380	*See* PB–89-182067/XAB			
77-037-413	14:43373	*See* PB–89-181440/XAB			
77-068-417	14:43378	*See* PB–89-181515/XAB			
HL–					
89/1085	14:41734	*See* NSS/G–106			
HZ/RAP–					
102	14:41761	*See* DOE/HWP–79			
IAE–					
4528/3	14:44023	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635277/JAW	MF-000
4566/4	14:41981	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635479/JAW	MF-000
4575-11	14:42505	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635060/JAW	MF-000
4595/4	14:41959	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635499/JAW	MF-000
4623/12	14:43766	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633953/JAW	MF-000
4663/6	14:44199	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634427/JAW	MF-000
4692/7	14:44262	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632035/JAW	MF-000
4719/3	14:44338	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635676/JAW	MF-000
IAEA-AL–					
020	14:42629	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634732/JAW	MF-000
IAEA-CN–					
50-B-4-8	14:44250	*See* CEA-CONF–9689			
IAEA-TECDOC–					
491	14:41955	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89635489/JAW	MF-000
495	14:44263	NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS		DE89634440/JAW	MF-000
501	14:43562	NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS		DE89635283/JAW	MF-000
IDA-M–					
305	14:44404	*See* AD-A–206885/6/XAB			
444	14:42905	*See* AD-A–207174/4/XAB			
IDA-P–					
2004	14:43937	*See* AD-A–205318/9/XAB			
2083	14:43938	*See* AD-A–205319/7/XAB			
IEA–					
9015961	14:41869	NTIS (US Sales Only), PC A07/MF A01 - OSTI		DE89015961/JAW	MF-000
IEA-SHCP–					
9B-1	14:41870	NTIS (US Sales Only), PC A08/MF A01 - OSTI		DE89016434/JAW	MF-000

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IFUSP-P–					
766	14:42453	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634930/JAW	MF-000
IFVE-OEA–					
88-47	14:43168	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635582/JAW	MF-000
IFVE-ONF–					
88-26	14:43100	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635437/JAW	MF-000
IFVE-OUNK–					
88-132	14:43101	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89633443/JAW	MF-000
IKE–					
4-126	14:44372	NTIS (US Sales Only), PC A07/MF A01; NTIS (US Sales Only), PC A07/MF A01		DE89795971/JAW	MF-000
IL/ENR/AE–					
89/01	14:41849	*See* PB–89-178503/XAB			
IL/ENR/RE-SP–					
89/01-3	14:42283	*See* PB–89-174536/XAB			
IL/ENR/RE/SP–					
89/01-2	14:42282	*See* PB–89-174528/XAB			
IN2P3–					
89-01	14:43861	NTIS (US Sales Only), PC A13/MF A01		DE89903207/JAW	MF-000
INDC(SEC)–					
097/UN	14:44397	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89635660/JAW	MF-000
098/UN	14:44398	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635668/JAW	MF-000
INFN-LNF–					
89-013(PT)	14:43819	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632137/JAW	MF-000
INFO–					
0180-2	14:42716	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89634756/JAW	MF-000
0180-2A	14:42717	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89634757/JAW	MF-000
0195-2	14:41711	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635602/JAW	MF-000
0225	14:42052	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635486/JAW	MF-000
0226	14:42053	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635487/JAW	MF-000
0233	14:42630	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634689/JAW	MF-000
0240	14:42247	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89635642/JAW	MF-000
0250-3	14:42997	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89635442/JAW	MF-000
0251	14:41996	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89635544/JAW	MF-000
0254-1	14:42998	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635443/JAW	MF-000
0263	14:41787	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635400/JAW	MF-000
0265	14:43697	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89635115/JAW	MF-000
0266	14:44024	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635278/JAW	MF-000
0267	14:41712	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635617/JAW	MF-000
0268	14:41997	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89635546/JAW	MF-000
0269	14:44025	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635279/JAW	MF-000
0271	14:41998	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635547/JAW	MF-000
0272	14:42063	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635123/JAW	MF-000
0277	14:42064	NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS		DE89635267/JAW	MF-000
INIS-SU–					
100	14:43878	NTIS (US Sales Only), PC A09/MF A01		DE89012201/JAW	MF-000
101	14:42725	NTIS (US Sales Only), PC A06/MF A01; INIS		DE89012194/JAW	MF-000
102	14:43706	NTIS (US Sales Only), PC A04/MF A01; INIS		DE89012199/JAW	MF-000
102	14:44127	NTIS (US Sales Only), PC A04/MF A01; INIS			MF-000
103/A	14:44009	NTIS (US Sales Only), PC A04/MF A01; INIS		DE89012203/JAW	MF-000
104/A	14:42624	NTIS (US Sales Only), PC A11/MF A01; INIS		DE89012195/JAW	MF-000
106	14:42625	NTIS (US Sales Only), PC A05/MF A01; INIS		DE89012197/JAW	MF-000
109/A	14:43707	NTIS (US Sales Only), PC A04/MF A01; INIS		DE89012198/JAW	MF-000
96	14:43705	NTIS (US Sales Only), PC A07/MF A01; INIS		DE89012202/JAW	MF-000
99/A	14:41792	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635405/JAW	MF-000
INIS-mf–					
11472	14:41507	NTIS (US Sales Only), PC A02/MF A01 - OSTI		DE89635597/JAW	MF-000
11473	14:43169	NTIS (US Sales Only), PC A03/MF A01 - OSTI		DE89635567/JAW	MF-000
11474	14:43265	NTIS (US Sales Only), PC A02/MF A01 - OSTI		DE89635598/JAW	MF-000
11475	14:43170	NTIS (US Sales Only), PC A03/MF A01 - OSTI		DE89635568/JAW	MF-000
11476	14:41788	NTIS (US Sales Only), PC A02/MF A01 - OSTI		DE89635413/JAW	MF-000
11477	14:41789	NTIS (US Sales Only), PC A03/MF A01 - OSTI		DE89635414/JAW	MF-000
11478	14:43604	NTIS (US Sales Only), PC A02/MF A01 - OSTI		DE89635218/JAW	MF-000
11484	14:42957	NTIS (US Sales Only), PC A24/MF A01 - OSTI; INIS		DE89633367/JAW	MF-000
11492	14:44034	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635274/JAW	MF-000
11496	14:44282	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89634457/JAW	MF-000
11500	14:44283	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89632031/JAW	MF-000
11503	14:43872	NTIS (US Sales Only), PC A07/MF A01		DE89012204/JAW	MF-000
11506	14:41999	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635548/JAW	MF-000
11507	14:41778	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635650/JAW	MF-000
11508	14:41714	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635618/JAW	MF-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
11509	14:41779	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635646/JAW	MF-000
11510	14:41637	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89635108/JAW	MF-000
11511	14:41715	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635619/JAW	MF-000
11512	14:43047	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635426/JAW	MF-000
11513	14:42065	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89635262/JAW	MF-000
11937	14:42016	NTIS (US Sales Only), PC A04/MF A01		DE89795480/JAW	MF-000
11989	14:42636	NTIS (US Sales Only), PC A10/MF A01		DE89796170/JAW	MF-000
11991	14:43329	NTIS (US Sales Only), PC A05/MF A01		DE89911031/JAW	MF-000
11995	14:43003	NTIS (US Sales Only), PC A03/MF A01		DE89795694/JAW	MF-000
INS–					
707	14:43882	NTIS (US Sales Only), PC A03/MF A01		DE89906566/JAW	MF-000
722	14:43883	NTIS (US Sales Only), PC A02/MF A01		DE89906617/JAW	MF-000
738	14:43931	NTIS (US Sales Only), PC A03/MF A01		DE89906504/JAW	MF-000
739	14:43208	NTIS (US Sales Only), PC A03/MF A01		DE89906505/JAW	MF-000
740	14:43725	NTIS (US Sales Only), PC A03/MF A01		DE89906506/JAW	MF-000
741	14:43836	NTIS (US Sales Only), PC A02/MF A01		DE89906507/JAW	MF-000
742	14:43884	NTIS (US Sales Only), PC A03/MF A01		DE89906508/JAW	MF-000
743	14:43103	NTIS (US Sales Only), PC A02/MF A01		DE89906509/JAW	MF-000
IPNO-DRE–					
89-02	14:43897	NTIS (US Sales Only), PC A03/MF A01		DE89908093/JAW	MF-000
IPPCZ–					
275	14:44203	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634428/JAW	MF-000
276	14:44204	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634364/JAW	MF-000
278	14:44205	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634387/JAW	MF-000
279	14:44206	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634365/JAW	MF-000
280	14:44286	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634490/JAW	MF-000
283	14:44287	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634491/JAW	MF-000
IPPJ–					
892	14:44207	NTIS (US Sales Only), PC A03/MF A01		DE89906585/JAW	MF-000
IPPJ-DT–					
143	14:44208	NTIS (US Sales Only), PC A02/MF A01		DE89906388/JAW	MF-000
IREQ–					
004D458	14:41937	Canaddan Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
183-T-357	14:41938	Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
231D488	14:41939	Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
417-U-475	14:42354	Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
7403	14:42173	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
7909	14:44188	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
ISH–					
117	14:43606	Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene			ND-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
121	14:43607	Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene			ND-000
ISI/RR–					
89-231	14:44345	*See* AD-A–206284/2/XAB			
ISN–					
88-101	14:43209	NTIS (US Sales Only), PC A12/MF A01		DE89908212/JAW	MF-000
88-62	14:43901	NTIS (US Sales Only), PC A07/MF A01		DE89908209/JAW	MF-000
ITEF–					
25(1988)	14:43210	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635586/JAW	MF-000
27(1988)	14:43211	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635587/JAW	MF-000
ITL–					
8509	14:42179	Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
8509	14:42180	Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
8509	14:42308	Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
ITP–					
87-156	14:43994	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89634637/JAW	MF-000
IVA–					
364	14:42280	NTIS (US Sales Only), PC A07		DE89902444/JAW	MF-000
IVO-A–					
04/89	14:42223	NTIS (US Sales Only), PC A08/MF A01		DE89787753/JAW	MF-000
IWS–					
076.13	14:43385	*See* PB–89-186662/XAB			
134.20.12	14:43384	*See* PB–89-186605/XAB			
134.20.14	14:41576	*See* PB–89-186621/XAB			
IYF–					
88-105	14:44179	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633885/JAW	MF-000
88-116	14:44209	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634388/JAW	MF-000
88-121	14:43837	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634577/JAW	MF-000
JA–					
6149	14:42933	*See* AD-A–206620/7/XAB			
6180	14:42934	*See* AD-A–206623/1/XAB			
6183	14:43017	*See* AD-A–206624/9/XAB			
JAERI–					
1316	14:44010	NTIS (US Sales Only), PC A14/MF A01		DE89906496/JAW	MF-000
JAERI-M–					
88-273	14:42072	NTIS (US Sales Only), PC A09/MF A01		DE89906497/JAW	MF-000
89-002	14:41960	NTIS (US Sales Only), PC A03/MF A01		DE89906454/JAW	MF-000
89-013	14:41985	NTIS (US Sales Only), PC A03/MF A01		DE89906470/JAW	MF-000
89-015	14:44400	NTIS (US Sales Only), PC A05/MF A01		DE89906473/JAW	MF-000
89-016	14:43048	NTIS (US Sales Only), PC A03/MF A01		DE89906464/JAW	MF-000
89-020	14:44210	NTIS (US Sales Only), PC A03/MF A01		DE89906498/JAW	MF-000
89-023	14:42909	NTIS (US Sales Only), PC A08/MF A01		DE89906499/JAW	MF-000
89-025	14:42095	NTIS (US Sales Only), PC A06/MF A01		DE89906500/JAW	MF-000
89-031	14:42910	NTIS (US Sales Only), PC A05/MF A01		DE89906501/JAW	MF-000
89-033	14:44211	NTIS (US Sales Only), PC A12/MF A01		DE89906468/JAW	MF-000
89-034	14:41961	NTIS (US Sales Only), PC A08/MF A01		DE89906474/JAW	MF-000
89-035	14:41986	NTIS (US Sales Only), PC A03/MF A01		DE89906502/JAW	MF-000
89-038	14:44288	NTIS (US Sales Only), PC A02/MF A01		DE89906475/JAW	MF-000
JET-R–					
89-02	14:44212	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634366/JAW	MF-000
89-03	14:44213	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634392/JAW	MF-000
89-05	14:44214	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89634393/JAW	MF-000
JINR–					
18-88-392	14:43566	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635378/JAW	MF-000
9-88-384	14:43104	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635434/JAW	MF-000
JINR-E–					
2-88-487	14:43838	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634578/JAW	MF-000
2-88-557	14:43864	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89633913/JAW	MF-000

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JINR-N–					
4(30)-88	14:44333	NTIS (US Sales Only), PC A06/MF A01; INIS		DE89012196/JAW	MF-000
5(31)-88	14:42425	NTIS (US Sales Only), PC A03/MF A01; INIS		DE89012200/JAW	MF-000
6(32)-88	14:43885	NTIS (US Sales Only), PC A03/MF A01; INIS		DE89012205/JAW	MF-000
JINR-R–					
3-88-555	14:43886	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634663/JAW	MF-000
4-88-539	14:43997	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89634622/JAW	MF-000
4-88-829	14:44181	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89633869/JAW	MF-000
7-88-388	14:43926	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634676/JAW	MF-000
JPL-D–					
6020	14:43792	*See* AD-A–205644/8/XAB			
Juel–					
2211	14:42459	Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek			ND-000
2253	14:43584	NTIS (US Sales Only), PC A10/MF A01		DE89911078/JAW	MF-000
2261	14:41987	NTIS (US Sales Only), PC A06/MF A01		DE89795717/JAW	MF-000
2263	14:42073	NTIS (US Sales Only), PC A05/MF A01		DE89911498/JAW	MF-000
2268	14:42591	NTIS (US Sales Only), PC A04/MF A01		DE89796053/JAW	MF-000
Juel-Conf–					
68	14:42248	Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek			ND-000
69	14:42249	NTIS (US Sales Only), PC A21/MF A01		DE89795784/JAW	MF-000
70	14:43667	Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek			ND-000
Juel-Spez–					
486	14:43998	NTIS (US Sales Only), PC A06/MF A01		DE89796018/JAW	MF-000
492	14:43330	Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek			ND-000
K/QT–					
295	14:41639	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016156/JAW	MF-506
KEK–					
88-9	14:44011	NTIS (US Sales Only), PC A10/MF A01		DE89906380/JAW	MF-000
88-10	14:43807	NTIS (US Sales Only), PC A16/MF A01		DE89906400/JAW	MF-000
88-11	14:43112	NTIS (US Sales Only), PC A03/MF A01		DE89906469/JAW	MF-000
KEK-PR–					
88-2	14:43043	NTIS (US Sales Only), PC A08/MF A01		DE89906588/JAW	MF-000
KFK–					
4476	14:41669	NTIS (US Sales Only), PC A20/MF A01		DE89795557/JAW	MF-000
4517	14:43446	NTIS (US Sales Only), PC A05/MF A01		DE89796043/JAW	MF-000
4530	14:44339	NTIS (US Sales Only), PC A11/MF A01		DE89911039/JAW	MF-000
4553	14:43771	NTIS (US Sales Only), PC A06/MF A01		DE89796038/JAW	MF-000
4554	14:43113	NTIS (US Sales Only), PC A05/MF A01		DE89796017/JAW	MF-000
4567	14:44289	NTIS (US Sales Only), PC A03/MF A01		DE89796042/JAW	MF-000
4568	14:41689	NTIS (US Sales Only), PC A07/MF A01		DE89796049/JAW	MF-000
4569	14:42460	NTIS (US Sales Only), PC A03/MF A01		DE89796041/JAW	MF-000
4575	14:42461	NTIS (US Sales Only), PC A08/MF A01		DE89796040/JAW	MF-000
4576	14:43608	NTIS (US Sales Only), PC A03/MF A01		DE89911094/JAW	MF-000
4579	14:42592	NTIS (US Sales Only), PC A06/MF A01		DE89796039/JAW	MF-000
KFTI–					
87-60	14:43772	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89633978/JAW	MF-000
KIYI–					
88-11	14:43215	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635573/JAW	MF-000
88-21	14:43267	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635599/JAW	MF-000
KURRI-TR–					
311	14:42691	NTIS (US Sales Only), PC A04/MF A01		DE89906638/JAW	MF-000
KWU-R–					
917/86/022	14:41889	NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01		DE89910947/JAW	MF-000
LA–					
11448-MS	14:44373	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015885/JAW	MF-706
11566-MS	14:41690	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015792/JAW	MF-732
11597-MS	14:41797	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014000/JAW	MF-713
11622-MS	14:44215	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016187/JAW	MF-426
LA-UR–					
89-2255	14:44374	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015239/JAW	MF-705
89-2335	14:43773	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015268/JAW	MF-701
89-2340	14:43139	NTIS, PC A03/MF A01 - OSTI		DE89015266/JAW	MF-414
89-2346	14:42509	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015264/JAW	MF-704
89-2375	14:43216	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015263/JAW	MF-705;MN-706

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89-2382	14:43217	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015261/JAW	MF-706
89-2384	14:43726	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015260/JAW	MF-702
89-2398	14:44189	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015259/JAW	MF-410
89-2404	14:43218	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015257/JAW	MF-410
89-2419	14:44132	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015255/JAW	MF-706
89-2422	14:43727	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015254/JAW	MF-000
89-2423	14:42692	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015411/JAW	MF-700
89-2451	14:43553	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015249/JAW	MF-411;MN-408
89-2469	14:44163	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015302/JAW	MF-706
89-2473	14:43774	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015301/JAW	MF-411
89-2474	14:44216	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015300/JAW	MF-420
89-2485	14:43798	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015298/JAW	MF-700
89-2534	14:41775	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015290/JAW	MF-700
89-2540	14:42693	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015289/JAW	MF-701
89-2547	14:43268	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015286/JAW	MF-706
89-2567	14:43304	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015280/JAW	MF-741
89-2572	14:42462	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015279/JAW	MF-704;MN-706
89-2587	14:44164	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015277/JAW	MF-411
89-2591	14:41793	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015276/JAW	MF-410;MN-406
LAPP-EXP–					
88-13	14:43049	NTIS (US Sales Only), PC A03/MF A01		DE89791990/JAW	MF-000
LBL–					
22860	14:41733	NTIS, PC A09/MF A01 - GPO - OSTI		TI89016225/JAW	MF-403;MN-402
25274	14:43799	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016467/JAW	MF-405;MN-406
25962	14:43050	NTIS, PC A02/MF A01 - OSTI		DE89016344/JAW	MF-414
25964	14:43114	NTIS, PC A02/MF A01 - OSTI		DE89016345/JAW	MF-414
25965	14:43115	NTIS, PC A02/MF A01 - OSTI		DE89016347/JAW	MF-414
25973	14:43116	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016312/JAW	MF-406;MN-405
25976	14:43140	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016343/JAW	MF-414
25978	14:43141	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016349/JAW	MF-414
25988	14:43074	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015336/JAW	MF-414
25992	14:43117	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016348/JAW	MF-414
26012	14:43118	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016346/JAW	MF-414
26537	14:42739	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015219/JAW	MF-401
26574	14:43804	*See* ANL-HEP-CP–89-19			
26795	14:43775	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016315/JAW	MF-411
26813	14:44217	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015222/JAW	MF-420
26882	14:43269	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016341/JAW	MF-406;MN-404
27108	14:44218	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015223/JAW	MF-420
27150	14:42740	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015337/JAW	MF-000
27180	14:43808	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016310/JAW	MF-414
27221	14:42463	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015347/JAW	MF-404
27234	14:43839	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015228/JAW	MF-414
27275	14:42217	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015221/JAW	MF-350
27327	14:43219	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015346/JAW	MF-414
27340	14:43809	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016118/JAW	MF-413
27351	14:43075	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015386/JAW	MF-414
27363	14:42311	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015231/JAW	MF-407;MN-350
27387	14:43902	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015342/JAW	MF-413
27392	14:43728	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016305/JAW	MF-413;MN-411
27402	14:44165	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015343/JAW	MF-411
27403	14:42510	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015232/JAW	MF-404
27404	14:42511	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015233/JAW	MF-404

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
27405	14:42512	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015235/JAW	MF-404
27457	14:43220	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015230/JAW	MF-406
27468	14:43776	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015338/JAW	MF-411
27481	14:43840	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016304/JAW	MF-414
LBL-PUB–					
5208	14:42242	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015332/JAW	MF-400
LCCCN–					
89-600014	14:43647	*See* PB–89-190102/XAB			
LIS–					
86	14:41926	NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A04/MF A01		DE89911268/JAW	MF-000
87	14:43354	NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01		DE89911267/JAW	MF-000
LMSC/F–					
307422	14:43752	*See* AD-A–207150/4/XAB			
LPNHEP–					
88-07	14:43810	NTIS (US Sales Only), PC A08/MF A01		DE89908090/JAW	MF-000
LU/GC–					
23440-4-9144	14:41803	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.			ND-000
LYCEN–					
89-03	14:43221	NTIS (US Sales Only), PC A02/MF A01		DE89908106/JAW	MF-000
Lund-MPh–					
88/14	14:43999	NTIS (US Sales Only), PC A04/MF A01		DE89796487/JAW	MF-000
MC/C–					
8609	14:41622	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.			ND-000
MC/SC–					
8609	14:41545	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.			ND-000
MECH–					
124	14:42493	*See* AD-A–206849/2/XAB			
MEM–					
1987	14:42266	Dept. of Energy and Mines, Legislative Bldg., Rm. 301, Winnipeg, MB, CAN R3C 0V8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
MEM/P–					
1986	14:41536	Manitoba Dept. of Energy and Mines, Legislative Bldg., Rm. 301, Winnipeg, Man., CAN R3C 0V8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
MEW/WS–					
8703	14:41828	Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
MH–					
722-G626	14:41826	Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
MHETA–					
87-110-1943	14:43391	*See* PB–89-187991/XAB			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
MHVDC–					
288-T-586	14:41940	Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
MICROLOG–					
87-00393	14:41534	*See* GU–OST85-00053			
87-01222	14:42442	*See* CANMET–7-185-144			
87-01223	14:41545	*See* MC/SC–8609			
87-01873	14:43426	*See* CPS–8702			
87-02101	14:43477	*See* SE/APC–39			
87-02203	14:42465	*See* MRC/IT–UP-M-502			
87-02207	14:43011	*See* WIC–RC203186			
87-02230	14:41622	*See* MC/C–8609			
87-02231	14:42347	*See* EGE–8610			
87-02526	14:42427	*See* ACI–370002			
87-02938	14:43487	*See* EC/WQB–87-121			
87-02956	14:41813	*See* EC/IWD–1987AP			
87-03004	14:42236	*See* ACUNS–8701			
87-03044	14:42376	*See* SA–8703			
87-03479	14:42384	*See* AEC–87-18-RR2			
87-03587	14:42383	*See* AEC–87-18/RR1			
87-03688	14:41557	*See* MOG–1986			
87-03689	14:41536	*See* MEM/P–1986			
87-03739	14:41815	*See* EC/IWD–1987O			
87-03764	14:41814	*See* EC/IWD–1987M			
87-03951	14:41817	*See* EC/IWD–1987S			
87-04000	14:42611	*See* SU/FAS–8610			
87-04010	14:42583	*See* CANMET–82-00106			
87-04014	14:42351	*See* ETDE/CA-MS–82-17E			
87-04313	14:42332	*See* MU/CRT–518			
87-04443	14:42343	*See* CES/MA–170			
87-04533	14:43009	*See* TS–8603			
87-04546	14:41803	*See* LU/GC–23440-4-9144			
87-04592	14:42913	*See* NRCC/IMR–26502			
87-04598	14:41847	*See* NRC–1986			
87-04602	14:41904	*See* NRC–27582			
87-04680	14:43470	*See* OME/APIOS–1987			
87-04686	14:43357	*See* OME/APIOS–1989E			
87-04711	14:43358	*See* OME/APIOS–1989F			
87-04818	14:43326	*See* EC–87-01			
87-04819	14:43542	*See* GU–87-02			
87-04907	14:43344	*See* BCMEP–8706			
87-04943	14:43519	*See* CPS–4HA1			
87-04945	14:41565	*See* EPS–13			
87-05113	14:41563	*See* AC/O–8704			
87-05171	14:42468	*See* ST–87R002			
87-05174	14:42320	*See* SPA–3-9178			
87-05175	14:42466	*See* NOVA–8609			
87-05279	14:43356	*See* OME/APIOS–005			
87-05369	14:41818	*See* EC/WID–1987			
87-05370	14:41816	*See* EC/IWD–1987Q			
87-05371	14:41820	*See* EC/WID–1987			
87-05372	14:41824	*See* EC/WID–1987S			
87-05373	14:41821	*See* EC/WID–1987BC			
87-05444	14:42266	*See* MEM–1987			
87-05781	14:41823	*See* EC/WID–1987Q			
87-05850	14:41819	*See* EC/WID–1987			
87-05852	14:41822	*See* EC/WID–1987O			
87-05955	14:42406	*See* OTC–RT-87-01			
87-05972	14:42243	*See* NRC–26556			
87-06058	14:41580	*See* SRBM–1987			
87-06107	14:43469	*See* EC/IWD–87-128			
87-06131	14:43343	*See* BCMEP–8704			
87-06181	14:41828	*See* MEW/WS–8703			
87-06204	14:41510	*See* SGS–9			
87-06345	14:43491	*See* OME/WRB–8704			
87-06356	14:43355	*See* OE/ARB–082-87-AQM			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
87-06370	14:43632	*See* EC–ARB-169-86			
87-06441	14:42715	*See* EMR/ER–87-45(TR)			
87-06442	14:42897	*See* EMR/ER–87-60(TR)			
88-06480	14:42319	*See* PSA–1987			
88-06481	14:42321	*See* TU/CBS–1989			
89-00267	14:42179	*See* ITL–8509			
89-00268	14:42180	*See* ITL–8509			
89-00269	14:42308	*See* ITL–8509			
89-00617	14:42302	*See* AA–8805			
89-00963	14:41806	*See* WLW–8802			
89-02174	14:43700	*See* EMR/MR–88-128			
89-02179	14:41549	*See* EMR–00329			
89-02222	14:41634	*See* CU/KC–88-3			
89-02223	14:41585	*See* EPS–2/PN/1			
89-02224	14:41586	*See* EPS–2/PN/1-F			
89-02225	14:41635	*See* CU/KC–88-5			
89-02440	14:41560	*See* DOME–100			
89-02485	14:41633	*See* TDGC–89-5			
89-02525	14:41829	*See* MM–1664			
89-02538	14:41917	*See* OH/CR–88-158-K			
89-02541	14:42593	*See* OH/CR–88-164-K			
89-02544	14:41941	*See* OH/ERD–88-166-K			
89-02545	14:41927	*See* OH/CR–88-202-K			
89-02547	14:41918	*See* OH/RD–88-77-K			
89-02548	14:41928	*See* OH/RD–88-63-K			
89-02549	14:41827	*See* OH/RD–88-151-K			
89-02550	14:42914	*See* OH/RD–88-69-K			
89-02551	14:41945	*See* OH/RD–88-98-K			
89-02553	14:41466	*See* OH/RD–88-132-K			
89-02557	14:41951	*See* OH/RD–8806			
89-02558	14:41929	*See* OH/RD–88-134-K			
89-02559	14:41946	*See* OH/RD–88-135-K			
89-02561	14:42357	*See* OH/RD–88-112K			
89-02562	14:41947	*See* OH/RD–88-149-K			
89-02563	14:41948	*See* OH/RD–88-167-K			
89-02564	14:43271	*See* OH/RD–88-64-K			
89-02565	14:41825	*See* OH/RD–88-11-K			
89-02568	14:41944	*See* OH/RD–88-86-K			
89-02571	14:41942	*See* OH/RD–88-66-K			
89-02572	14:41943	*See* OH/RD–88-67-K			
89-02617	14:42356	*See* OH/RD–87-333-K			
89-02851	14:41561	*See* PACE–86-2			
89-02880	14:41837	*See* ADI–1989			
MISC–					
89037	14:41704	*See* DOE/LLW–81			
89054	14:41436	NTIS, PC A03/MF A01 - OSTI		DE89016364/JAW	MF-101;MN-102
89059	14:41703	*See* DOE/ID–22079			
MLM–					
3601-OP	14:42464	NTIS, PC A03/MF A01 - OSTI		DE89015381/JAW	MF-704
3602-OP	14:43270	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015382/JAW	MF-704
MM–					
1664	14:41829	Canada Dept. of Fisheries and Oceans, Scientific Publications, 200 Kent Street, 14th. Floor, Ottawa, ON, CAN K1A 0E6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
MOG–					
1986	14:41557	Manitoba Oil and Gas Corporation, 870-330 Graham Ave., Winnipeg, MB, CAN R3C 4A5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
MRC/IT–					
UP-M-502	14:42465	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.			ND-000

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MRL-R–					
1146	14:42432	*See* AD-A–205888/1/XAB			
MRP/MSL–					
84-134(IR)	14:42694	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634690/JAW	MF-000
85-57(TR)	14:41638	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634921/JAW	MF-000
MTL-TR–					
89-4	14:42489	*See* AD-A–205430/2/XAB			
89-21	14:42495	*See* AD-A–207064/7/XAB			
MU/CRT–					
518	14:42332	Centre de recherche sur les transports, Universite@' de Montre@'al, CP 6128, Succursale A, Montre@'al, PQ, CAN H3C 3J7; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
NAC–					
87-05	14:43568	*See* PB–89-167183/XAB			
NASA-E–					
4446	14:42890	*See* AD-A–205373/4/XAB			
4675	14:41587	*See* AD-A–207009/2/XAB			
NBS/SP–					
250/19	14:43569	*See* PB–89-193858/XAB			
NBSIR–					
86/3420	14:41553	*See* PB–89-185581/XAB			
87/3504	14:42597	*See* PB–89-185573/XAB			
87/3534	14:44013	*See* PB–89-188809/XAB			
87/3619	14:42313	*See* PB–89-188619/XAB			
NCEL-UG–					
0014	14:43689	*See* AD-A–205986/3/XAB			
NCS-R–					
3	14:43222	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89633653/JAW	MF-000
NCS-TIB–					
88-04	14:43313	*See* AD-A–206549/8/XAB			
NDRL–					
3215	14:42800	*See* DOE/ER/00038–3215			
NEB–					
GH-3-89	14:41607	National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, ON, CAN K1A 0E5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
GH-5-88	14:41598	National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, ON, CAN K1A 0E5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
GH-5-88-F	14:41599	National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, ON, CAN K1A 0E5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
MH-2-88	14:41609	National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, ON, CAN K1A 0E5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
MH-2-88-F	14:41610	National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, ON, CAN K1A 0E5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
NEB-SS–					
EH-1-89	14:42267	National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, ON, CAN K1A 0E5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
GH-3-89-F	14:41608	National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, ON, CAN K1A 0E5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000

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NEI-DK–					
130	14:41462	Niro Atomizer A/S, Soeborg (Denmark)			ND-000
NEI-FI–					
78	14:42355	NTIS (US Sales Only), PC A03/MF A01		DE89902340/JAW	MF-000
NEI-NO–					
89	14:42225	NTIS (US Sales Only), PC A12		DE89902378/JAW	MF-000
90	14:43039	NTIS (US Sales Only), PC A14		DE89902379/JAW	MF-000
NGD–					
9(1983)	14:42000	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635549/JAW	MF-000
NIIAR–					
10(721)	14:43004	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635444/JAW	MF-000
20(731)	14:43005	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89633460/JAW	MF-000
32(763)	14:43006	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635445/JAW	MF-000
5(716)	14:42018	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635556/JAW	MF-000
6(737)	14:42049	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635480/JAW	MF-000
NIIEFA-P-E–					
0768	14:43076	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635428/JAW	MF-000
NIRS-AR–					
30	14:44340	NTIS (US Sales Only), PC A12/MF A01		DE89906672/JAW	MF-000
NIRS-M–					
69	14:42103	NTIS (US Sales Only), PC A11/MF A01		DE89906457/JAW	MF-000
NIRS-RSD–					
82	14:43447	NTIS (US Sales Only), PC A03/MF A01		DE89906611/JAW	MF-000
83	14:43585	NTIS (US Sales Only), PC A03/MF A01		DE89906612/JAW	MF-000
NISTIR–					
88/3722	14:42513	*See* PB–89-188569/XAB			
88/3808	14:43019	*See* PB–89-189344/XAB			
88/4012	14:42599	*See* PB–89-189328/XAB			
88/4014	14:42314	*See* PB–89-189237/XAB			
89/4073	14:42598	*See* PB–89-189138/XAB			
NMRI–					
89-14	14:43657	*See* AD-A–206152/1/XAB			
NOAA-TM-NMFS-F/NWC–					
156	14:43498	*See* PB–89-180632/XAB			
NOVA–					
8609	14:42466	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.			ND-000
NRC–					
1986	14:41847	National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, ON, CAN K1A 0R6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
26556	14:42243	National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, ON, CAN K1A 0R6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
27569	14:43331	National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, ON, CAN K1A 0R6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
27582	14:41904	National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, ON, CAN K1A 0R6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
NRCC/IMR–					
26502	14:42913	National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, ON, CAN K1A 0R6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000

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NRCN(LS)–					
021	14:43448	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89632926/JAW	MF-000
NRL-MR–					
6290	14:43739	*See* AD-A–205965/7/XAB			
6377	14:43736	*See* AD-A–205461/7/XAB			
6388	14:43016	*See* AD-A–206270/1/XAB			
6436	14:43751	*See* AD-A–207036/5/XAB			
NSS/G–					
106	14:41734	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635620/JAW	MF-000
NSS/R–					
121	14:43449	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635086/JAW	MF-000
NSWC-TR–					
88-76	14:42197	*See* AD-A–205756/0/XAB			
NTP-TR–					
280	14:43639	*See* PB–89-178529/XAB			
NUKEM-FuE–					
85039	14:41735	Copy held by UB/TIB Hannover.			MF-000
86008	14:41848	NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01		DE89795918/JAW	MF-000
NUREG–					
0020-Vol.13-No.7	14:41956	NTIS, PC A22/MF A01 - GPO - OSTI		TI89016376/JAW	MF-000
0304-Vol.14-No.1	14:42026	NTIS, PC A04/MF A01 - GPO - OSTI		TI89015316/JAW	MF-000
0525-Rev.15	14:41776	NTIS, PC A12/MF A01 - GPO - OSTI		TI89015830/JAW	MF-000
0936-Vol.8-No.2	14:42027	NTIS, PC A07/MF A01 - GPO - OSTI		TI89016666/JAW	MF-000
1229	14:42056	NTIS, PC A03/MF A01 - GPO - OSTI		TI89016466/JAW	MF-000
1371	14:41962	NTIS, PC A22/MF A01 - GPO - OSTI		TI89014340/JAW	MF-000
1375-Vol.1	14:41736	NTIS, PC A05/MF A01 - GPO - OSTI		TI89016109/JAW	MF-000
NUREG/CR–					
2000-Vol.8-No.6	14:42028	NTIS, PC A05/MF A01 - GPO - OSTI		TI89015397/JAW	MF-000
2331-Vol.8-No.4	14:42128	NTIS, PC A08/MF A01 - GPO - OSTI		TI89016444/JAW	MF-000
4864-Vol.1	14:41733	*See* LBL–22860			
5175	14:42066	NTIS, PC A10/MF A01 - GPO - OSTI		TI89016086/JAW	MF-000
5225-Add.1	14:42067	NTIS, PC A07/MF A01 - GPO - OSTI		TI89016372/JAW	MF-000
5348	14:42057	NTIS, PC A03/MF A01 - GPO - OSTI		TI89015396/JAW	MF-000
NUREG/IA–					
0014	14:42129	NTIS, PC A04/MF A01 - GPO - OSTI		TI89015946/JAW	MF-000
NUTP–					
1E	14:41737	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635621/JAW	MF-000
3E	14:42695	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89634685/JAW	MF-000
NWC-TP–					
6869	14:43341	*See* AD-A–206321/2/XAB			
6869-SUMM	14:43342	*See* AD-A–206322/0/XAB			
OCS/MMS–					
88/0025	14:41570	*See* PB–89-168157/XAB			
OE/ARB–					
082-87-AQM	14:43355	Ontario. Ministry of the Environment. A.P.I.O.S. Coordination Office, 40 St. Clair Avenue West, 7th Floor, Toronto, ON, CAN M4V 1M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
OH–					
84-276-K	14:42046	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89635470/JAW	MF-000
85-156-K	14:44334	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635690/JAW	MF-000
85-20-K	14:44341	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635677/JAW	MF-000
85-239-K	14:42001	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635550/JAW	MF-000
85-248-K	14:42002	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635551/JAW	MF-000
85-258-K	14:42069	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635263/JAW	MF-000
85-271-K	14:41739	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635622/JAW	MF-000
85-293-K	14:42003	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635552/JAW	MF-000
85-42-K	14:44342	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635691/JAW	MF-000
85-59-K	14:42068	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635264/JAW	MF-000
85-98-K	14:41738	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635623/JAW	MF-000
87-114-K	14:42070	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89635268/JAW	MF-000
OH/CR–					
88-158-K	14:41917	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
88-164-K	14:42593	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-202-K	14:41927	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
OH/ERD–					
88-166-K	14:41941	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
OH/RD–					
199T425	14:41949	Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
208-D-455	14:41950	Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
87-333-K	14:42356	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-11-K	14:41825	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-112K	14:42357	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-132-K	14:41466	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-134-K	14:41929	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-135-K	14:41946	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-149-K	14:41947	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-151-K	14:41827	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000

OH/RD–

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
88-167-K	14:41948	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-63-K	14:41928	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-64-K	14:43271	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-66-K	14:41942	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-67-K	14:41943	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-69-K	14:42914	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-77-K	14:41918	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-86-K	14:41944	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-98-K	14:41945	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
8806	14:41951	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
OME/APIOS–					
005	14:43356	Coordination Office, 40 St. Clair Avenue West, 7th Floor, Toronto, ON, CAN M4V 1M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1987	14:43470	Ontario. Ministry of the Environment. A.P.I.O.S. Coordination Office, 40 St. Clair Avenue West, 7th Floor, Toronto, ON, CAN M4V 1M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1989E	14:43357	Ontario. Ministry of the Environment. A.P.I.O.S. Coordination Office, 40 St. Clair Avenue West, 7th Floor, Toronto, ON, CAN M4V 1M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
1989F	14:43358	Ontario. Ministry of the Environment. A.P.I.O.S. Coordination Office, 40 St. Clair Avenue West, 7th Floor, Toronto, ON, CAN M4V 1M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
OME/WRB–					
8704	14:43491	Ontario Ministry of the Environment, Public Information Office, 135 St. Clair Ave. West, Toronto, ON, CAN M4V 1P5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
ONR-TR–					
12	14:42939	*See* AD-A–207134/8/XAB			
ORF–					
P-5340/FG	14:43450	Canada Mortgage and Housing Corporation, Annex Bldg., 628 Montreal Rd., Ottawa, ON, CAN K1A 0P7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
ORNL/FTR–					
3295	14:42281	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016395/JAW	MF-920
3322	14:43077	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015321/JAW	MF-414
3331	14:43359	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015371/JAW	MF-408
3332	14:43567	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016158/JAW	MF-408
3333	14:43305	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015399/JAW	MF-700
3334	14:41467	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015414/JAW	MF-402
3335	14:41759	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015370/JAW	MF-400
3336	14:44012	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015398/JAW	MF-413
3339	14:41780	NTIS, PC A04/MF A01 - OSTI		DE89016456/JAW	MF-600
3341	14:44133	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016394/JAW	MF-410
3345	14:42301	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016428/JAW	MF-000
ORNL/M–					
878	14:43635	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015413/JAW	MF-000
889	14:43636	NTIS, PC A08/MF A01 - OSTI		DE89016276/JAW	MF-802
890	14:42019	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016457/JAW	MF-530
ORNL/NSIC–					
200-Vol.8-No.6	14:42028	*See* NUREG/CR–2000-Vol.8-No.6			
ORNL/RASA–					
88/41	14:43451	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015403/JAW	MF-511
88/42	14:43452	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015404/JAW	MF-511
88/44	14:43453	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015405/JAW	MF-511
88/52	14:43454	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015402/JAW	MF-511
88/53	14:43455	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015406/JAW	MF-511
OTA-E–					
394	14:41571	*See* PB–89-169239/XAB			
OTC–					
RT-87-01	14:42406	Ont. Min. of Transportation and Communications, R & D Branch, 1201 Wilson Ave., Downsview, ON, CAN M3M 1J8; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
OULNS–					
88-11	14:43208	*See* INS–739			
PACE–					
86-2	14:41561	Petroleum Association for Conservation of the Canadian Environment (PACE), 1202-275 Slater St., Ottawa, ON, CAN K1P 5H9; $25.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
PAM–					
436	14:44350	*See* AD-A–206860/9/XAB			
PB–					
89-159735/XAB	14:41566	NTIS, PC A19			ND-00
89-159743/XAB	14:41508	NTIS, PC A19			ND-00
89-159750/XAB	14:41567	NTIS, PC A20/MF A01			ND-00
89-159768/XAB	14:41568	NTIS, PC A20			ND-00
89-159776/XAB	14:41569	NTIS, PC A20			ND-00
89-162945/XAB	14:42333	NTIS, PC A11/MF A01			ND-00

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89-164396/XAB	14:42390	NTIS, PC EE05/MF E05			ND-00
89-164628/XAB	14:42421	NTIS, PC EE04/MF E04			ND-00
89-166607/XAB	14:43492	NTIS, PC A06/MF A01			ND-00
89-166763/XAB	14:42358	NTIS, PC A05/MF A01			ND-00
89-167183/XAB	14:43568	NTIS, PC EE04/MF E04			ND-00
89-167357/XAB	14:43007	NTIS, PC EE04/MF E04			ND-00
89-167969/XAB	14:43520	NTIS, PC A04/MF A01			ND-00
89-168090/XAB	14:41794	NTIS, PC EE05/MF E05			ND-00
89-168116/XAB	14:41811	NTIS, PC EE05/MF E05			ND-00
89-168157/XAB	14:41570	NTIS, PC A06/MF A01			ND-00
89-168272/XAB	14:43637	NTIS, PC EE05/MF A01			ND-00
89-168793/XAB	14:43471	NTIS, PC A06/MF A01			ND-00
89-168967/XAB	14:41473	NTIS, PC A03/MF A01			ND-00
89-168975/XAB	14:41474	NTIS, PC A04/MF A01			ND-00
89-169197/XAB	14:43521	NTIS, PC A11/MF A01			ND-00
89-169205/XAB	14:43457	NTIS, PC A10/MF A01			ND-00
89-169239/XAB	14:41571	NTIS, PC A07/MF A01			ND-00
89-169791/XAB	14:43493	NTIS, PC EE03/MF A01			ND-00
89-169825/XAB	14:43522	NTIS, PC A13/MF A01			ND-00
89-169841/XAB	14:41930	NTIS, PC A05/MF A01			ND-00
89-169858/XAB	14:43360	NTIS, PC A06/MF A01			ND-00
89-169866/XAB	14:43419	NTIS, PC A04/MF A01			ND-00
89-169874/XAB	14:43361	NTIS, PC A04/MF A01			ND-00
89-169882/XAB	14:42408	NTIS, PC A04/MF A01			ND-00
89-169890/XAB	14:43515	NTIS, PC A03/MF A01			ND-00
89-169973/XAB	14:43420	NTIS, PC A03/MF A01			ND-00
89-170039/XAB	14:43729	NTIS, PC EE03/MF A01			ND-00
89-170203/XAB	14:42409	NTISCP T99			ND-00
89-170237/XAB	14:42334	NTIS, PC A12/MF A01			ND-00
89-170351/XAB	14:42335	NTIS, PC A22/MF A01			ND-00
89-170377/XAB	14:42336	NTIS, PC A21/MF A01			ND-00
89-170476/XAB	14:42312	NTIS, PC EE06/MF E06			ND-00
89-170575/XAB	14:42289	NTIS, PC A09/MF A01			ND-00
89-170690/XAB	14:41500	NTIS, PC EE09/MF E09			ND-00
89-170708/XAB	14:41501	NTIS, PC EE07/MF E07			ND-00
89-171524/XAB	14:43494	NTIS, PC A03/MF A01			ND-00
89-172233/XAB	14:42359	NTIS, PC A05/MF A01			ND-00
89-172241/XAB	14:41890	NTIS, PC A12/MF A01			ND-00
89-172258/XAB	14:42360	NTIS, PC A06/MF A01			ND-00
89-172308/XAB	14:43417	NTIS, PC A03/MF A01			ND-00
89-172654/XAB	14:43472	NTIS, PC EE99/MF E99			ND-00
89-172662/XAB	14:43473	NTIS, PC A05/MF A01			ND-00
89-172670/XAB	14:43474	NTIS, PC A16/MF A01			ND-00
89-172688/XAB	14:43475	NTIS, PC A99/MF E04			ND-00
89-172696/XAB	14:43476	NTIS, PC A99/MF E04			ND-00
89-173058/XAB	14:43730	NTIS, PC A04/MF A01			ND-00
89-173215/XAB	14:43362	NTIS, PC A03/MF A01			ND-00
89-173223/XAB	14:43363	NTIS, PC A02/MF A01			ND-00
89-173751/XAB	14:43523	NTIS, PC A03/MF A01			ND-00
89-174171/XAB	14:43364	NTIS, PC A03/MF A01			ND-00
89-174528/XAB	14:42282	NTIS, PC A21/MF A01			ND-00
89-174536/XAB	14:42283	NTIS, PC A99/MF A01			ND-00
89-174726/XAB	14:43638	NTIS, PC A04/MF A01			ND-00
89-174742/XAB	14:43365	NTIS, PC A07/MF A01			ND-00
89-175335/XAB	14:41601	NTIS, PC A08/MF A01			ND-00
89-175350/XAB	14:41502	NTIS, PC EE04/MF E04			ND-00
89-175368/XAB	14:42337	NTIS, PC EE05/MF E05			ND-00
89-175475/XAB	14:43524	NTIS, PC A06/MF A01			ND-00
89-175541/XAB	14:42226	NTIS, PC A11/MF A01			ND-00
89-175608/XAB	14:42284	NTISCP T08			ND-00
89-175616/XAB	14:41807	NTIS, PC A03/MF A01			ND-00
89-175624/XAB	14:43495	NTIS, PC A03/MF A01			ND-00
89-176333/XAB	14:41877	NTIS, PC EE04/MF E04			ND-00
89-177299/XAB	14:41952	NTIS, PC EE04/MF E04			ND-00
89-177315/XAB	14:41475	NTIS, PC EE04/MF E04			ND-00
89-177364/XAB	14:41476	NTIS, PC EE04/MF E04			ND-00
89-177380/XAB	14:41953	NTIS, PC EE04/MF E04			ND-00
89-177513/XAB	14:42361	NTIS, PC EE04/MF E04			ND-00
89-177836/XAB	14:42594	NTIS, PC A03/MF A01			ND-00
89-177877/XAB	14:41795	NTIS, PC A04/MF A01			ND-00
89-177943/XAB	14:42402	NTIS, PC A06/MF A01			ND-00

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
89-177950/XAB	14:42410	NTIS, PC A03/MF A01			ND-00
89-178065/XAB	14:41550	NTIS, PC A03/MF A01			ND-00
89-178073/XAB	14:41551	NTIS, PC A03/MF A01			ND-00
89-178131/XAB	14:43550	NTIS, PC A03/MF A01			ND-00
89-178503/XAB	14:41849	NTIS, PC A03/MF A01			ND-00
89-178529/XAB	14:43639	NTIS, PC A09/MF A01			ND-00
89-178552/XAB	14:43517	NTIS, PC A04/MF A01			ND-00
89-178578/XAB	14:43496	NTIS, PC A03/MF A01			ND-00
89-178602/XAB	14:43497	NTIS, PC A07/MF A01			ND-00
89-178792/XAB	14:42422	NTIS, PC A04/MF A01			ND-00
89-178826/XAB	14:43698	NTIS, PC A04/MF A01			ND-00
89-178883/XAB	14:41552	NTIS, PC A05/MF A01			ND-00
89-178891/XAB	14:43640	NTIS, PC A05/MF A01			ND-00
89-178958/XAB	14:41850	NTIS, PC A03/MF A01			ND-00
89-178990/XAB	14:42227	NTIS, PC A08/MF A01			ND-00
89-179311/XAB	14:43051	NTIS, PC A03/MF A01			ND-00
89-179337/XAB	14:42898	NTIS, PC A03/MF A01			ND-00
89-179493/XAB	14:42228	NTIS, PC A09/MF A01			ND-00
89-179865/XAB	14:43525	NTIS, PC A04/MF A01			ND-00
89-179899/XAB	14:43526	NTIS, PC A06/MF A01			ND-00
89-179907/XAB	14:43527	NTIS, PC A03/MF A01			ND-00
89-179915/XAB	14:43528	NTIS, PC A03/MF A01			ND-00
89-179923/XAB	14:43529	NTIS, PC A03/MF A01			ND-00
89-179956/XAB	14:43530	NTIS, PC A03/MF A01			ND-00
89-179964/XAB	14:43531	NTIS, PC A03/MF A01			ND-00
89-179972/XAB	14:42229	NTIS, PC A05/MF A01			ND-00
89-179980/XAB	14:42230	NTIS, PC A03/MF A01			ND-00
89-179998/XAB	14:43549	NTIS, PC A15/MF A01			ND-00
89-180053/XAB	14:43458	NTIS, PC A11/MF A01			ND-00
89-180061/XAB	14:43459	NTIS, PC A11/MF A01			ND-00
89-180095/XAB	14:43436	NTIS, PC A08/MF A01			ND-00
89-180145/XAB	14:41883	NTIS, PC A03/MF A01			ND-00
89-180210/XAB	14:42595	NTIS, PC A03/MF A01			ND-00
89-180384/XAB	14:42596	NTIS, PC A03/MF A01			ND-00
89-180418/XAB	14:41871	NTIS, PC A03/MF A01			ND-00
89-180483/XAB	14:43366	NTIS, PC A07/MF A01			ND-00
89-180632/XAB	14:43498	NTIS, PC A04/MF A01			ND-00
89-180822/XAB	14:42411	NTIS, PC A03/MF A01			ND-00
89-180830/XAB	14:42231	NTIS, PC A09/MF A01			ND-00
89-181028/XAB	14:41572	NTIS, PC EE99/MF E99			ND-00
89-181036/XAB	14:41573	NTIS, PC A04/MF A01			ND-00
89-181044/XAB	14:41574	NTIS, PC A22/MF A01			ND-00
89-181051/XAB	14:41575	NTIS, PC A15/MF A01			ND-00
89-181101/XAB	14:43367	NTIS, PC A05/MF A01			ND-00
89-181143/XAB	14:41604	NTIS, PC A04/MF A01			ND-00
89-181234/XAB	14:42362	NTIS, PC A03/MF A01			ND-00
89-181275/XAB	14:43368	NTIS, PC A03/MF A01			ND-00
89-181283/XAB	14:42363	NTIS, PC A02/MF A01			ND-00
89-181291/XAB	14:43369	NTIS, PC A03/MF A01			ND-00
89-181309/XAB	14:43437	NTIS, PC A02/MF A01			ND-00
89-181341/XAB	14:43370	NTIS, PC A02/MF A01			ND-00
89-181366/XAB	14:43641	NTIS, PC A07/MF A01			ND-00
89-181374/XAB	14:43371	NTIS, PC A05/MF A01			ND-00
89-181424/XAB	14:43372	NTIS, PC A10/MF A01			ND-00
89-181440/XAB	14:43373	NTIS, PC A03/MF A01			ND-00
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89-181465/XAB	14:43375	NTIS, PC A04/MF A01			ND-00
89-181473/XAB	14:43376	NTIS, PC A03/MF A01			ND-00
89-181507/XAB	14:43377	NTIS, PC A03/MF A01			ND-00
89-181515/XAB	14:43378	NTIS, PC A03/MF A01			ND-00
89-181788/XAB	14:43379	NTIS, PC A07/MF A01			ND-00
89-181796/XAB	14:42412	NTIS, PC A14/MF A01			ND-00
89-181945/XAB	14:43499	NTIS, PC A09/MF A01			ND-00
89-181986/XAB	14:43642	NTIS, PC A03/MF A01			ND-00
89-182042/XAB	14:43578	NTIS, PC A04/MF A01			ND-00
89-182067/XAB	14:43380	NTIS, PC A03/MF A01			ND-00
89-182414/XAB	14:43460	NTIS, PC A13/MF A01			ND-00
89-182513/XAB	14:43532	NTIS, PC A03/MF A01			ND-00
89-182687/XAB	14:42232	NTIS, PC A25/MF A01			ND-00
89-182729/XAB	14:43381	NTIS, PC A08/MF A01			ND-00
89-182919/XAB	14:41562	NTIS, PC A03/MF A01			ND-00

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
89-182984/XAB	14:41830	NTIS, PC A04/MF A01			ND-00
89-183024/XAB	14:43500	NTIS, PC A03/MF A01			ND-00
89-183065/XAB	14:43643	NTIS, PC A04/MF A01			ND-00
89-183206/XAB	14:43501	NTIS, PC A10/MF A01			ND-00
89-183669/XAB	14:44375	NTIS, PC EE03/MF A01			ND-00
89-184071/XAB	14:43533	NTIS, PC A06/MF A01			ND-00
89-184501/XAB	14:41804	NTIS, PC A03/MF A01			ND-00
89-184519/XAB	14:43644	NTIS, PC A05/MF A01			ND-00
89-184584/XAB	14:43382	NTIS, PC A03/MF A01			ND-00
89-184618/XAB	14:43534	NTIS, PC A06/MF A01			ND-00
89-184626/XAB	14:42364	NTIS, PC A10/MF A01			ND-00
89-184709/XAB	14:43383	NTIS, PC A05/MF A01			ND-00
89-184949/XAB	14:43731	NTIS, PC EE02/MF A01			ND-00
89-185334/XAB	14:42264	NTISMF A01			ND-00
89-185409/XAB	14:44376	NTIS, PC EE03/MF A01			ND-00
89-185573/XAB	14:42597	NTIS, PC A03/MF A01			ND-00
89-185581/XAB	14:41553	NTIS, PC A04/MF A01			ND-00
89-185706/XAB	14:43645	NTIS, PC A07/MF A01			ND-00
89-185862/XAB	14:41437	NTIS, PC A05/MF A01			ND-00
89-185870/XAB	14:41596	NTIS, PC A08/MF A01			ND-00
89-186035/XAB	14:41603	NTIS, PC A06/MF A01			ND-00
89-186068/XAB	14:42233	NTISCP T10			ND-00
89-186076/XAB	14:42234	NTIS, PC A04/MF A01			ND-00
89-186464/XAB	14:43777	NTIS(Order as PB–89-186449)			ND-00
89-186472/XAB	14:43778	NTIS(Order as PB–89-186449)			ND-00
89-186605/XAB	14:43384	NTIS, PC A03/MF A01			ND-00
89-186621/XAB	14:41576	NTIS, PC A03/MF A01			ND-00
89-186662/XAB	14:43385	NTIS, PC A03/MF A01			ND-00
89-186670/XAB	14:43386	NTIS, PC A02/MF A01			ND-00
89-186688/XAB	14:43387	NTIS, PC A03/MF A01			ND-00
89-186696/XAB	14:43388	NTIS, PC A03/MF A01			ND-00
89-186936/XAB	14:41577	NTIS, PC A03/MF A01			ND-00
89-186944/XAB	14:41578	NTIS, PC A14/MF A01			ND-00
89-187157/XAB	14:41812	NTIS, PC A03/MF A01			ND-00
89-187165/XAB	14:43389	NTIS, PC A03/MF A01			ND-00
89-187173/XAB	14:43646	NTIS, PC A05/MF A01			ND-00
89-187421/XAB	14:43535	NTIS, PC A03/MF A01			ND-00
89-187629/XAB	14:42391	NTIS, PC A07/MF A01			ND-00
89-187637/XAB	14:42235	NTIS, PC A05/MF A01			ND-00
89-187645/XAB	14:42365	NTIS, PC A03/MF A01			ND-00
89-187652/XAB	14:42366	NTIS, PC A13/MF A01			ND-00
89-187942/XAB	14:41503	NTIS, PC A03/MF A01			ND-00
89-187959/XAB	14:43390	NTIS, PC A03/MF A01			ND-00
89-187991/XAB	14:43391	NTIS, PC A03/MF A01			ND-00
89-188015/XAB	14:43392	NTIS, PC A03/MF A01			ND-00
89-188031/XAB	14:43663	NTIS, PC A03/MF A01			ND-00
89-188064/XAB	14:43393	NTIS, PC A03/MF A01			ND-00
89-188080/XAB	14:43394	NTIS, PC A03/MF A01			ND-00
89-188098/XAB	14:43395	NTIS, PC A06/MF A01			ND-00
89-188114/XAB	14:43396	NTIS, PC A03/MF A01			ND-00
89-188569/XAB	14:42513	NTIS, PC A06/MF A01			ND-00
89-188619/XAB	14:42313	NTIS, PC A04/MF A01			ND-00
89-188718/XAB	14:43461	NTIS, PC A03/MF A01			ND-00
89-188726/XAB	14:43536	NTIS, PC A04/MF A01			ND-00
89-188742/XAB	14:42367	NTIS, PC A06/MF A01			ND-00
89-188783/XAB	14:43537	NTIS, PC A15/MF A01			ND-00
89-188809/XAB	14:44013	NTIS, PC A05/MF A01			ND-00
89-188817/XAB	14:43462	NTIS, PC A05/MF A01			ND-00
89-188833/XAB	14:41805	NTIS, PC A03/MF A01			ND-00
89-188866/XAB	14:41617	NTIS, PC A07/MF A01			ND-00
89-188874/XAB	14:41616	NTIS, PC A05/MF A01			ND-00
89-188882/XAB	14:41605	NTIS, PC A05/MF A01			ND-00
89-188890/XAB	14:41450	NTIS, PC A03/MF A01			ND-00
89-188916/XAB	14:41592	NTIS, PC A04/MF A01			ND-00
89-189138/XAB	14:42598	NTIS, PC A05/MF A01			ND-00
89-189187/XAB	14:42899	NTIS, PC A09/MF A01			ND-00
89-189237/XAB	14:42314	NTIS, PC A04/MF A01			ND-00
89-189328/XAB	14:42599	NTIS, PC A04/MF A01			ND-00
89-189344/XAB	14:43019	NTIS, PC A06/MF A01			ND-00
89-189385/XAB	14:41589	NTIS, PC A12/MF A01			ND-00
89-189393/XAB	14:42315	NTIS, PC A08/MF A01			ND-00

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89-189401/XAB	14:43397	NTIS, PC A03/MF A01			ND-00
89-189468/XAB	14:43538	NTIS, PC A04/MF A01			ND-00
89-189484/XAB	14:43539	NTIS, PC A03/MF A01			ND-00
89-189500/XAB	14:42392	NTIS, PC A05/MF A01			ND-00
89-189518/XAB	14:43540	NTIS, PC A03/MF A01			ND-00
89-189526/XAB	14:43463	NTIS, PC A05/MF A01			ND-00
89-189559/XAB	14:42368	NTIS, PC A04/MF A01			ND-00
89-189781/XAB	14:41831	NTIS, PC A05/MF A01			ND-00
89-190102/XAB	14:43647	NTIS, PC A03/MF A01			ND-00
89-190383/XAB	14:43648	NTIS, PC A07/MF A01			ND-00
89-190581/XAB	14:43541	NTIS, PC A13/MF A01			ND-00
89-190615/XAB	14:42393	NTIS, PC A10/MF A01			ND-00
89-190755/XAB	14:41509	NTIS, PC A03/MF A01			ND-00
89-190821/XAB	14:43464	NTIS, PC A03/MF A01			ND-00
89-190912/XAB	14:42316	NTIS, PC A12/MF A01			ND-00
89-190920/XAB	14:42317	NTIS, PC A05/MF A01			ND-00
89-191233/XAB	14:41438	NTIS, PC A09/MF A01			ND-00
89-191241/XAB	14:41439	NTIS, PC A07/MF A01			ND-00
89-191258/XAB	14:41440	NTIS, PC A99/MF A01			ND-00
89-191357/XAB	14:43502	NTIS, PC A05/MF A01			ND-00
89-192686/XAB	14:42239	NTIS, PC A05/MF A01			ND-00
89-193858/XAB	14:43569	NTIS, PC A04/MF A01			ND-00
89-194005/XAB	14:41602	NTIS, PC A05/MF A01			ND-00
89-194021/XAB	14:41606	NTIS, PC A06/MF A01			ND-00
89-194120/XAB	14:42295	NTIS, PC A03/MF A01			ND-00
89-194187/XAB	14:41468	NTIS, PC A07/MF A01			ND-00
89-196679/XAB	14:43503	NTIS, PC A06/MF A01			ND-00
89-196828/XAB	14:43398	NTIS, PC A17/MF A01			ND-00
89-861405/XAB	14:43399	NTISPC N01/MF N01			ND-00
89-861587/XAB	14:43438	NTISPC N01/MF N01			ND-00
89-861595/XAB	14:42394	NTISPC N01/MF N01			ND-00
89-861611/XAB	14:41579	NTISPC N01/MF N01			ND-00
89-861629/XAB	14:42369	NTISPC N01/MF N01			ND-00
89-861637/XAB	14:42370	NTISPC N01/MF N01			ND-00
89-861645/XAB	14:42371	NTISPC N01/MF N01			ND-00
89-861686/XAB	14:42915	NTISPC N01/MF N01			ND-00
89-861710/XAB	14:42318	NTISPC N01/MF N01			ND-00
89-861785/XAB	14:41919	NTISPC N01/MF N01			ND-00
89-861843/XAB	14:42423	NTISPC N01/MF N01			ND-00
89-861850/XAB	14:43465	NTISPC N01/MF N01			ND-00
89-861868/XAB	14:43466	NTISPC N01/MF N01			ND-00
89-861892/XAB	14:43504	NTISPC N01/MF N01			ND-00
89-861918/XAB	14:41808	NTISPC N01/MF N01			ND-00
89-861926/XAB	14:41809	NTISPC N01/MF N01			ND-00
89-862049/XAB	14:43649	NTISPC N01/MF N01			ND-00
89-862080/XAB	14:41799	NTISPC N01/MF N01			ND-00
89-862122/XAB	14:41872	NTISPC N01/MF N01			ND-00
89-862189/XAB	14:42257	NTISPC N01/MF N01			ND-00
89-862197/XAB	14:42240	NTISPC N01/MF N01			ND-00
89-862320/XAB	14:42514	NTISPC N01/MF N01			ND-00
89-862452/XAB	14:42600	NTISPC N01/MF N01			ND-00
89-862643/XAB	14:43516	NTISPC N01/MF N01			ND-00
89-862650/XAB	14:42241	NTISPC N01/MF N01			ND-00
89-862916/XAB	14:43505	NTISPC N01/MF N01			ND-00
89-862965/XAB	14:42601	NTISPC N01/MF N01			ND-00
89-862973/XAB	14:42602	NTISPC N01/MF N01			ND-00
89-863450/XAB	14:42467	NTISPC N01/MF N01			ND-00
89-863518/XAB	14:42372	NTISPC N01/MF N01			ND-00
89-863575/XAB	14:41469	NTISPC N01/MF N01			ND-00
89-863583/XAB	14:42373	NTISPC N01/MF N01			ND-00
89-863617/XAB	14:43650	NTISPC N01/MF N01			ND-00
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89-863757/XAB	14:42603	NTISPC N01/MF N01			ND-00
89-863849/XAB	14:43664	NTISPC N01/MF N01			ND-00
89-863864/XAB	14:43418	NTISPC N01/MF N01			ND-00
89-863880/XAB	14:42374	NTISPC N01/MF N01			ND-00
89-863955/XAB	14:42604	NTISPC N01/MF N01			ND-00
89-864037/XAB	14:42605	NTISPC N01/MF N01			ND-00
89-864086/XAB	14:42290	NTISPC N01/MF N01			ND-00
89-864102/XAB	14:43652	NTISPC N01/MF N01			ND-00

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89-864169/XAB	14:42405	NTISPC N01/MF N01			ND-00
89-864193/XAB	14:43020	NTISPC N01/MF N01			ND-00
89-864235/XAB	14:44377	NTISPC N01/MF N01			ND-00
89-864243/XAB	14:44378	NTISPC N01/MF N01			ND-00
89-864250/XAB	14:42606	NTISPC N01/MF N01			ND-00
89-864367/XAB	14:42375	NTISPC N01/MF N01			ND-00
89-864433/XAB	14:43032	NTISPC N01/MF N01			ND-00
89-864458/XAB	14:42986	NTISPC N01/MF N01			ND-00
89-864649/XAB	14:43008	NTISPC N01/MF N01			ND-00
89-864706/XAB	14:41444	NTISPC N01/MF N01			ND-00
89-864730/XAB	14:43518	NTISPC N01/MF N01			ND-00
89-864755/XAB	14:43653	NTISPC N01/MF N01			ND-00
89-864763/XAB	14:43654	NTISPC N01/MF N01			ND-00
89-864938/XAB	14:43665	NTISPC N01/MF N01			ND-00
PCCF-T–					
8806	14:43811	NTIS (US Sales Only), PC A06/MF A01		DE89908092/JAW	MF-000
8807	14:43889	NTIS (US Sales Only), PC A14/MF A01		DE89792008/JAW	MF-000
PNL–					
6820-Vol.1	14:41740	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014008/JAW	MF-502
6820-Vol.2	14:41741	NTIS, PC A99/MF A01 - OSTI		DE89014005/JAW	MF-502
6906-Vol.1	14:42916	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015190/JAW	MF-812
6928	14:44401	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016241/JAW	MF-705
6929	14:44402	NTIS, PC A25/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016247/JAW	MF-705
PNL-SA–					
17177	14:42338	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015833/JAW	MF-528
PPPL–					
2640	14:44219	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014009/JAW	PC-420;STD-421;STD-426
PPRP/AD–					
89-1	14:43381	*See* PB–89-182729/XAB			
PR-HS–					
19	14:44335	*See* AECL–8848			
PR-PHS-HS–					
4	14:44336	*See* AECL–9681			
PSA–					
1987	14:42319	Canada Mortgage and Housing Corporation, Annex Bldg., 628 Montreal Rd., Ottawa, ON, CAN K1A 0P7; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
PTB-W–					
37	14:42218	NTIS (US Sales Only), PC A08/MF A01; NTIS (US Sales Only), PC A08/MF A01		DE89795859/JAW	MF-000
PW–					
602031	14:43403	Canada. Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, CAN K1A 0M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
8805	14:43400	Canada. Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, CAN K1A 0M2; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
8806-4	14:43401	Canada. Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, CAN K1A 0M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
8806-5	14:43402	Canada. Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, CAN K1A 0M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
PWA–					
44/88	14:41669	*See* KFK–4476			
Q–					
128	14:42800	*See* DOE/ER/00038–3215			
QAUM–					
88/36	14:43729	*See* PB–89-170039/XAB			
R/BOU–					
1497	14:41877	*See* PB–89-176333/XAB			
1512E	14:42390	*See* PB–89-164396/XAB			
RADC-TR–					
88-216	14:42904	*See* AD-A–206800/5/XAB			
RAL–					
89-030	14:43241	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635588/JAW	MF-000
89-031	14:44134	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634306/JAW	MF-000
89-036	14:43841	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89634579/JAW	MF-000
89-037	14:44290	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89634434/JAW	MF-000
RCM–					
01788	14:42881	NTIS (US Sales Only), PC A03/MF A01		DE89795973/JAW	MF-000
02188	14:42741	NTIS (US Sales Only), PC A04/MF A01		DE89795972/JAW	MF-000
RCNP-P–					
100	14:44000	NTIS (US Sales Only), PC A11/MF A01		DE89906614/JAW	MF-000
RDA-TR–					
101800-010	14:43319	*See* AD-A–955415/5/XAB			
135603-009	14:43759	*See* AD-A–206987/0/XAB			
REC-ERC–					
87-9	14:43698	*See* PB–89-178826/XAB			
REG/G–					
1.147-Rev.7	14:42029	NTIS, PC A02/MF A01 - GPO - OSTI		TI89016460/JAW	MF-000
3.64	14:41742	NTIS, PC A03/MF A01 - GPO - OSTI		TI89016459/JAW	MF-000
REPT–					
10-3095-VOL-1	14:41473	*See* PB–89-168967/XAB			
10-3095-VOL-2	14:41474	*See* PB–89-168975/XAB			
78-4	14:41550	*See* PB–89-178065/XAB			
87-50	14:41551	*See* PB–89-178073/XAB			
88-96	14:44376	*See* PB–89-185409/XAB			
89/01	14:43731	*See* PB–89-184949/XAB			
RERF-TR–					
0-86	14:43619	NTIS (US Sales Only), PC A03/MF A01		DE89906610/JAW	MF-000
0-87	14:43620	NTIS (US Sales Only), PC A03/MF A01		DE89906572/JAW	MF-000
10-88	14:44039	NTIS (US Sales Only), PC A02/MF A01		DE89906460/JAW	MF-000
3-88	14:43621	NTIS (US Sales Only), PC A03/MF A01		DE89906462/JAW	MF-000
5-88	14:43622	NTIS (US Sales Only), PC A06/MF A01		DE89906463/JAW	MF-000
6-88	14:43623	NTIS (US Sales Only), PC A03/MF A01		DE89906459/JAW	MF-000
RNIIRP–					
88-2	14:41796	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635406/JAW	MF-000
ROM2F–					
89-004	14:44182	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89633886/JAW	MF-000
RSRE-MEMO–					
4244	14:44346	*See* AD-A–206313/9/XAB			
RVH–					
165D286	14:43673	Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
SA–					
8703	14:42376	Saskatchewan Agriculture, Regina, SK, CAN S4S 0B1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
SAIC–					
86/1547	14:42316	*See* PB–89-190912/XAB			
86/1749	14:42317	*See* PB–89-190920/XAB			
86/65555	14:42403	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016116/JAW	MF-111
89/1114	14:42057	*See* NUREG/CR–5348			
SAND–					
87-0323	14:41733	*See* LBL–22860			
88-1432	14:44379	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013994/JAW	MF-405
88-1605	14:42066	*See* NUREG/CR–5175			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
SAND–					
88-2448C	14:42607	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016180/JAW	MF-741
88-2911C	14:43279	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016416/JAW	MF-706
88-2948	14:41743	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015193/JAW	MF-721
88-3060C	14:42917	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015390/JAW	MF-706
88-3403C	14:43021	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015393/JAW	MF-701
89-0287C	14:42742	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015849/JAW	MF-000
89-0466	14:44380	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013996/JAW	MF-905
89-0763C	14:42608	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016178/JAW	MF-706;MN-704
89-0918C	14:42515	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016418/JAW	MF-000
89-0963C	14:42918	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015408/JAW	MF-722
89-1208C	14:42609	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015887/JAW	MF-704
89-1461	14:42516	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013995/JAW	MF-704
89-1692C	14:42131	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015392/JAW	MF-000
89-1696C	14:42610	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015842/JAW	MF-704
89-1869C	14:44403	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015848/JAW	MF-700
89-1876C	14:42517	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016183/JAW	MF-704
89-8508	14:42424	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011327/JAW	MF-700
SBM–					
8308	14:43404	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
SC–					
8708	14:43033	Canada Mortgage and Housing Corporation, Annex Bldg., 628 Montreal Rd., Ottawa, ON, CAN K1A 0P7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
SCIENTIFIC–					
1	14:43746	*See* AD-A–206816/1/XAB			
1	14:43747	*See* AD-A–206819/5/XAB			
SE/APC–					
39	14:43477	Saskatchewan. Saskatchewan Environment & Public Safety, 3085 Albert St., Regina, SK, CAN S4S 0B1; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
SERI/STR–					
211-3238	14:41851	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009449/JAW	MF-273
211-3522	14:41852	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009433/JAW	MF-273
SFB–					
210/ET-50	14:43332	Karlsruhe Univ. (T.H.) (Germany, F.R.). Sonderforschungsbereich 210 Stroemungsmechanische Bemessungsgrundlagen fuer Bauwerke			ND-000
237-49(prepr.)	14:44183	Bochum Univ. (Germany, F.R.). Sonderforschungsbereich 237 - Unordnung und Grosse Fluktuationen			ND-000
SFWE–					
1989	14:41835	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
SGD–					
534-PT-2	14:43730	*See* PB–89-173058/XAB			
SGS–					
9	14:41510	Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
SH-R–					
4-88-2112	14:43690	*See* AD-A–206979/7/XAB			
SHA–					
C-258	14:42377	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
SIEMENS-KWU-U9–					
414/89/004	14:41971	NTIS (US Sales Only), PC A03/MF A01		DE89795701/JAW	MF-000
SKB-TR–					
88-24	14:42702	NTIS (US Sales Only), PC A03/MF A01		DE89796489/JAW	MF-000
88-30	14:41744	NTIS (US Sales Only), PC A04/MF A01		DE89796490/JAW	MF-000
89-01	14:43699	NTIS (US Sales Only), PC A03/MF A01		DE89912024/JAW	MF-000
89-02	14:41745	NTIS (US Sales Only), PC A04/MF A01		DE89912025/JAW	MF-000
89-19	14:44381	NTIS (US Sales Only), PC A03/MF A01		DE89912026/JAW	MF-000
SLAC-PUB–					
5003	14:43842	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013982/JAW	PC-414
5021	14:43078	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013987/JAW	PC-414
5028	14:43242	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013986/JAW	PC-414
5041	14:43243	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013990/JAW	PC-414
SLU-ISG–					
41	14:41853	*See* STEV-EO–89-12			
SPA–					
3-9178	14:42320	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
SPC–					
144T307	14:41954	Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
234-SAN	14:43320	*See* AD-A–955418/9/XAB			
SRBM–					
1987	14:41580	Surface Rights Board, P.O. Box 158, Virden, MB, CAN R0M 2C0; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
SRI-ENV–					
88-1023-5914	14:41930	*See* PB–89-169841/XAB			
88-1215-6666	14:41456	*See* DOE/PC/88868–T1			
SRI-MP–					
88-234	14:43758	*See* AD-A–206936/7/XAB			
88-292	14:43794	*See* AD-A–206678/5/XAB			
SRI-W–					
78-17302	14:43318	*See* AD-A–955412/2/XAB			
SRL–					
07-F-1989	14:42937	*See* AD-A–207052/2/XAB			
SSI–					
89-01	14:44135	NTIS (US Sales Only), PC A02/MF A01		DE89796488/JAW	MF-000
ST–					
87R002	14:42468	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.			ND-000
STEV-EO–					
89-12	14:41853	NTIS (US Sales Only), PC A07/MF A01		DE89902459/JAW	MF-000
STEV-FBT–					
89-1	14:41488	NTIS (US Sales Only), PC A03/MF A01		DE89902387/JAW	MF-000
89-3	14:41489	NTIS (US Sales Only), PC A03/MF A01		DE89902386/JAW	MF-000
89-13	14:41490	NTIS (US Sales Only), PC A03/MF A01		DE89902388/JAW	MF-000
89-14	14:43034	NTIS (US Sales Only), PC A03/MF A01		DE89902389/JAW	MF-000
SU/FAS–					
8610	14:42611	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.			ND-000
SWA–					
88/033	14:43493	*See* PB–89-169791/XAB			
SWRI–					
1280	14:42412	*See* PB–89-181796/XAB			
17-7958-842	14:42891	*See* AD-A–206041/6/XAB			
1781/201	14:41603	*See* PB–89-186035/XAB			
T–					
18888	14:44023	*See* IAE–4528/3			

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TD–					
2699	14:44401	*See* PNL–6928			
2699	14:44402	*See* PNL–6929			
TDA–					
89-GRI-001	14:41604	*See* PB–89-181143/XAB			
TDGC–					
89-5	14:41633	New Brunswick Dept. of Natural Resources and Energy, P.O. Box 6000, Fredericton, NB, CAN E3B 5H1; $4.65 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
TECHNICALDIGEST–					
1	14:41811	*See* PB–89-168116/XAB			
TM–					
88/10	14:41500	*See* PB–89-170690/XAB			
88/13	14:41501	*See* PB–89-170708/XAB			
TR–					
0088(3061)-1	14:42929	*See* AD-A–205915/2/XAB			
0088(3940-06)-3	14:43742	*See* AD-A–206227/1/XAB			
0088(3940-06)-6	14:43744	*See* AD-A–206459/0/XAB			
1	14:42576	*See* AD-A–205975/6/XAB			
12	14:42437	*See* AD-A–207117/3/XAB			
252	14:44349	*See* AD-A–206852/6/XAB			
261	14:44348	*See* AD-A–206657/9/XAB			
426	14:42490	*See* AD-A–206003/6/XAB			
426	14:42930	*See* AD-A–206005/1/XAB			
4315-040-89	14:42315	*See* PB–89-189393/XAB			
TRB/NCHRP/SYN–					
144	14:42595	*See* PB–89-180210/XAB			
TS–					
8603	14:43009	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.			ND-000
TU/CBS–					
1989	14:42321	Canada Mortgage and Housing Corporation, Annex Bldg., 628 Montreal Rd., Ottawa, ON, CAN K1A 0P7; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
UBA-FB–					
84-138	14:42322	NTIS (US Sales Only), PC A04/MF A01; NTIS (US Sales Only), PC A04/MF A01		DE89910945/JAW	MF-000
86-081	14:42413	Umweltbundesamt, Berlin (Germany, F.R.)			ND-000
UCD/ET–					
89/1	14:43648	*See* PB–89-190383/XAB			
UCID–					
21636	14:44220	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013975/JAW	MF-701
UCRL–					
100013	14:44292	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016635/JAW	MF-712
100106	14:43244	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016655/JAW	MF-706
100316	14:43119	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016641/JAW	MF-000
100358-Rev.1	14:44293	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016650/JAW	MF-706
100365	14:42920	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016638/JAW	MF-706
100416	14:43120	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016648/JAW	MF-000
100420	14:42943	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015731/JAW	MF-706
100539	14:44166	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016646/JAW	MF-404
101025	14:43306	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016651/JAW	MF-713
101244	14:42612	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015729/JAW	MF-707
101311	14:44167	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016642/JAW	MF-700
101356	14:42518	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016644/JAW	MF-704
101357	14:42519	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016643/JAW	MF-704
101498	14:43625	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015334/JAW	MF-408
101583	14:44190	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016654/JAW	MF-700
21110	14:43656	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016664/JAW	MF-000
21163	14:41491	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016653/JAW	MF-101
21165	14:42987	NTIS, PC A12/MF A01 - OSTI		DE89015709/JAW	MF-706
21188	14:44221	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015723/JAW	MF-712
53917	14:43624	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014001/JAW	PC-702
53927	14:43439	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014002/JAW	PC-706

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
99314	14:44136	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015727/JAW	MF-712
99646	14:42942	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016657/JAW	MF-712
99648	14:42919	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014046/JAW	MF-722
99782	14:43079	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016656/JAW	MF-000
UILU-ENG–					
88-4014	14:43796	*See* AD-A–207054/8/XAB			
UMTA-DC–					
06-0559-87-2	14:42334	*See* PB–89-170237/XAB			
USABRDL-TR–					
8918	14:43629	*See* AD-A–206976/3/XAB			
USAFOEHL–					
89-003EQ0013ASC	14:42382	*See* AD-A–207102/5/XAB			
89-009EQ0105BWA	14:42342	*See* AD-A–207101/7/XAB			
USCG-COMDTINST-M–					
16450.2H	14:43502	*See* PB–89-191357/XAB			
USDA/AER–					
606	14:43495	*See* PB–89-175624/XAB			
607	14:41807	*See* PB–89-175616/XAB			
USGS-OFR–					
89-74	14:41703	*See* DOE/ID–22079			
UTNL-R–					
0227	14:42074	NTIS (US Sales Only), PC A05/MF A01		DE89906569/JAW	MF-000
UTRC/R–					
89-927162-1	14:42936	*See* AD-A–206713/0/XAB			
VTT-TUTK–					
581	14:42378	NTIS (US Sales Only), PC A06/MF A01		DE89902336/JAW	MF-000
583	14:42323	NTIS (US Sales Only), PC A04/MF A01		DE89902337/JAW	MF-000
584	14:43674	NTIS (US Sales Only), PC A08/MF A01		DE89902339/JAW	MF-000
586	14:42324	NTIS (US Sales Only), PC A05/MF A01		DE89902338/JAW	MF-000
587	14:41920	NTIS (US Sales Only), PC A04/MF A01		DE89902335/JAW	MF-000
589	14:42469	NTIS (US Sales Only), PC A04/MF A01		DE89902334/JAW	MF-000
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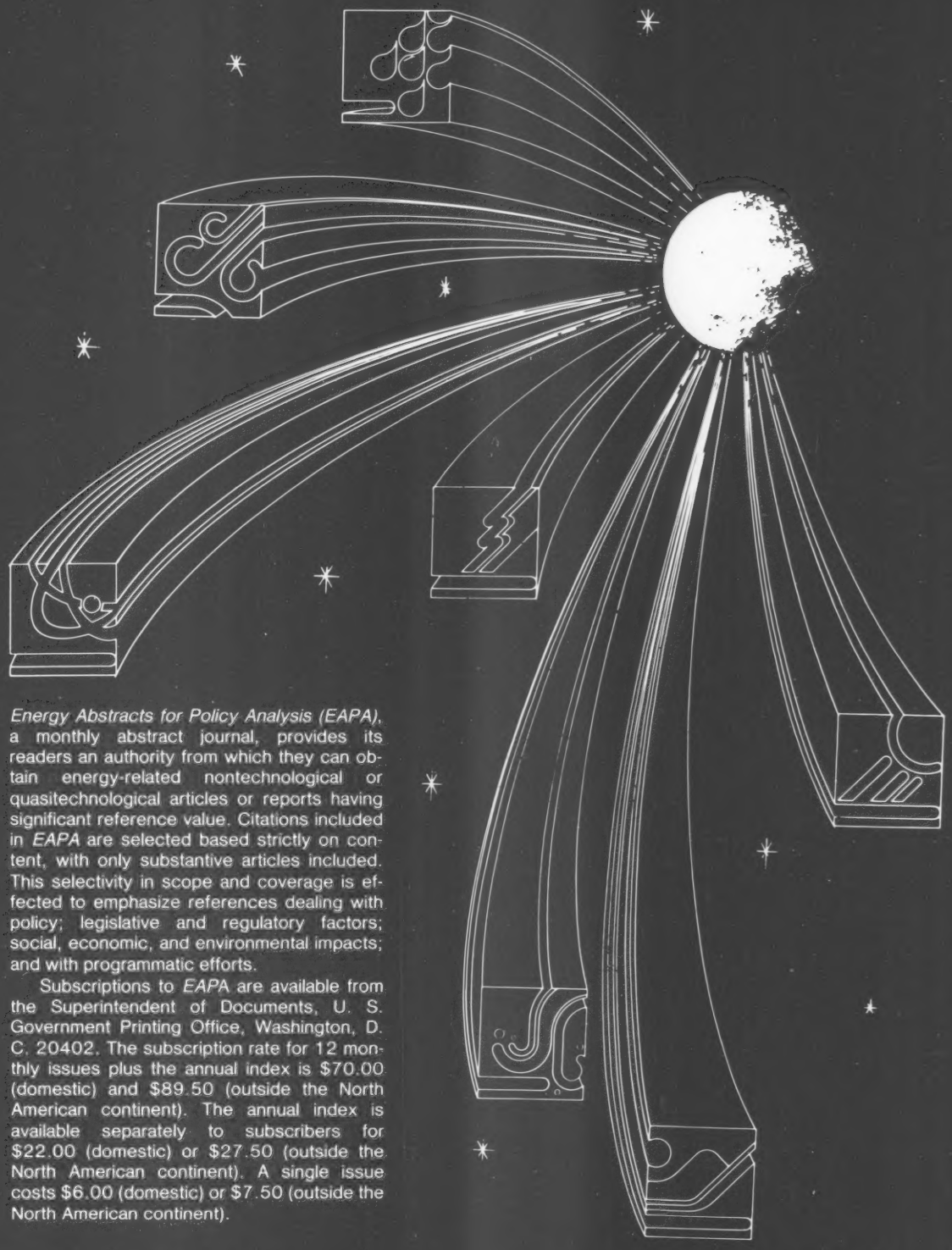

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Baton Rouge, LA 70803
(504) 388-2570

LOUISIANA TECHNICAL UNIV. LIBRARY
Documents Department
Ruston, LA 71272
(318) 257-4962

UNIVERSITY OF MAINE
Raymond H. Fogler Library
Tri-State Regional Documents Depository
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UNIVERSITY OF MARYLAND
McKeldin Lib.-Doc. Div.
College Park, MD 20742
(301) 454-3034

BOSTON PUBLIC LIBRARY
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Boston, MA 02117
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DETROIT PUBLIC LIBRARY
Sociology Department
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Detroit, MI 48202
(313) 833-1409

MICHIGAN STATE LIBRARY
P.O. Box 30007
Lansing, MI 48909
(517) 373-0640

UNIVERSITY OF MINNESOTA
Government Pubs. Division
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309 19th Avenue South
Minneapolis, MN 55455
(612) 373-7813

UNIV. OF MISSISSIPPI LIB.
Documents Department
University, MS 38677
(601) 232-5857

UNIV. OF MONTANA
Mansfield Library
Documents Division
Missoula, MT 59812
(406) 243-6700

NEBRASKA LIBRARY COMM.
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Lincoln, NE 68508
(402) 471-2045
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Albuquerque, NM 87131
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NEW MEXICO STATE LIBRARY
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Santa Fe, NM 87501
(505) 827-2033, ext. 22

NEW YORK STATE LIBRARY
Empire State Plaza
Albany, NY 12230
(518) 474-5563

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
Wilson Library
BA/SS Documents Division
Chapel Hill, NC 27515
(919) 962-1321

UNIVERSITY OF NORTH DAKOTA
Chester Fritz Library
Documents Department
Grand Forks, ND 58202
(701) 777-2617, ext. 27
(in cooperation with North Dakota State Univ. Library)

STATE LIBRARY OF OHIO
Documents Department
65 South Front Street
Columbus, OH 43215
(614) 462-7051

OKLAHOMA DEPT. OF LIBRARIES
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200 NE 18th Street
Oklahoma City, OK 73105
(405) 521-2502

OKLAHOMA STATE UNIV. LIB.
Documents Department
Stillwater, OK 74078
(405) 624-6546

PORTLAND STATE UNIV. LIB.
Documents Department
P.O. Box 1151
Portland, OR 97207
(503) 229-3673

STATE LIBRARY OF PENN.
Government Pub. Section
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Harrisburg, PA 17105
(717) 787-3752

TEXAS STATE LIBRARY
Public Services Department
P.O. Box 12927-Cap. Sta.
Austin, TX 78753
(512) 471-2996

TEXAS TECH. UNIV. LIBRARY
Govt. Documents Department
Lubbock, TX 79409
(806) 742-2268

UTAH STATE UNIVERSITY
Merrill Library, U.M.C. 30
Logan, UT 84322
(801) 750-2682

UNIVERSITY OF VIRGINIA
Alderman Lib.-Public Doc.
Charlottesville, VA 22901
(804) 924-3133

WASHINGTON STATE LIBRARY
Documents Section
Olympia, WA 98504
(206) 753-4027

WEST VIRGINIA UNIV. LIB.
Documents Department
Morgantown, WV 26506
(304) 293-3640

MILWAUKEE PUBLIC LIBRARY
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Milwaukee, WI 53233
(414) 278-3000

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Government Pub. Section
816 State Street
Madison, WI 53706
(608) 262-4347

WYOMING STATE LIBRARY
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Cheyenne, WY 82002
(307) 777-6344

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